THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXVI. No. 1955.] LONDON, OCTOBER 30, 1900. [52ND YEAR. PRICE 6d.

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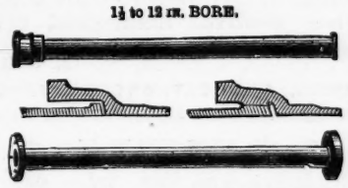

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At "The SHEFFIELD TELEGRAPH" Offices.
Reprinted from "The SHEFFIELD TELEGRAPH" June 27, 1900.
A SAVING IN FUEL OF £18 PER WEEK.

A couple of months ago when coal, which formerly cost us 8s. per ton rose to 12s. 6d., we read a lecture on the cost of steam production by John Holliday, in which the following paragraph appeared:—

Mr. Bryan Donkin, M.Inst.C.E., has published figures from some tests he carried out with different kinds of fuel in the same boiler, the conditions in all cases being the same; the results are comparable on the basis of the cost of fuel required to evaporate 1000 gallons.

Kind of Fuel.	Cost of Fuel per Ton.	Water Evaporated per Pound of Fuel.	Cost of Fuel per 1000 Gallons Evaporated.
	s. d.	lbs.	s. d.
A. Dust Coke	5 0	6	3 8
B. „ Welsh Coal . . .	10 0	8	5 3
C. Large „	22 0	9	10 11

Discovering that the Sheffield Gas Company made a considerable quantity of coke dust, which they gave away to builders and others, we entered into a contract for a supply for three years. Having a spare boiler, we had Meldrums' forced draught fitted, and soon discovered that coke dust made a very satisfactory fuel for steam raising. Our second boiler was then fitted, and we are now burning coke dust on the two almost exclusively. From an economical point of view, the experiment is very satisfactory, as will be seen from the following figures:—

Average week, Coal only, on One Boiler.

	£ s. d.
45 Tons at 12s. 6d.	28 2 6
Ashes at 2s., Seven Loads	14 0
	£28 16 6

Present Consumption on Two Boilers.

	£ s. d.
Six Tons of Coal at 9s. 3d.	3 15 6
Coke Dust	3 4 0
Two extra Stokers	2 12 0
Flues cleaning	10 0
Ashes, 12 Loads at 2s.	1 4 0
	£10 5 6

We shall be pleased to show the arrangement to anyone interested in the subject of the economical production of steam. There is no smoke from the chimney stack of the "Telegraph" Office, which is another good point in favour of coke dust as fuel.

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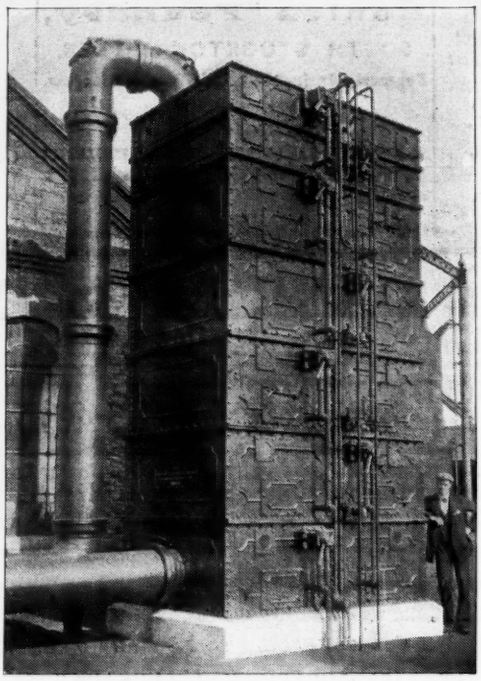

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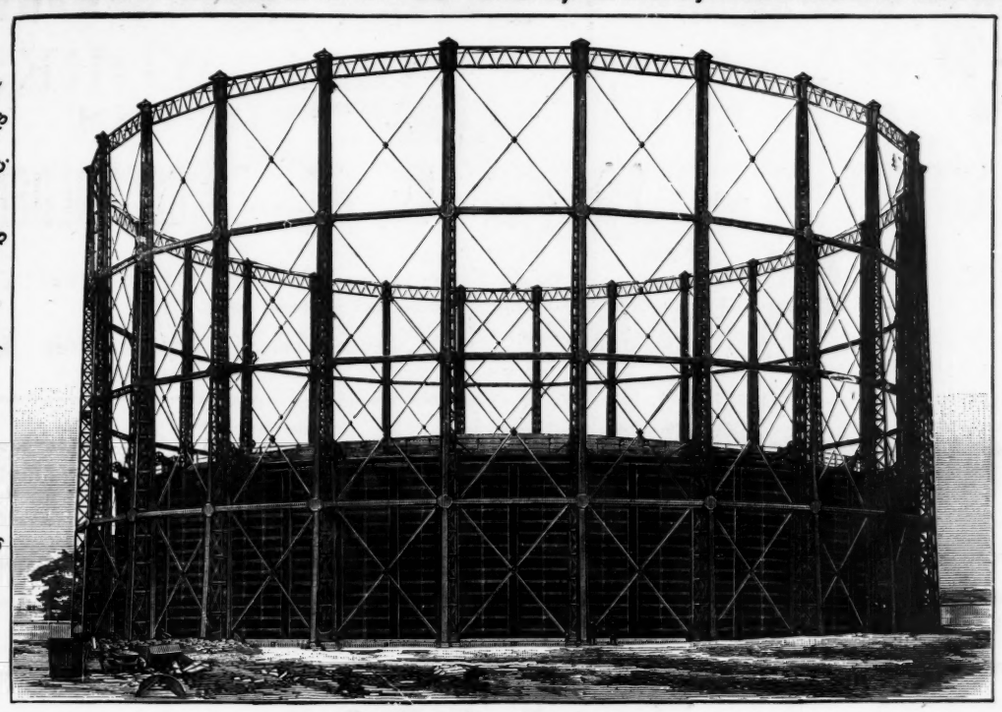

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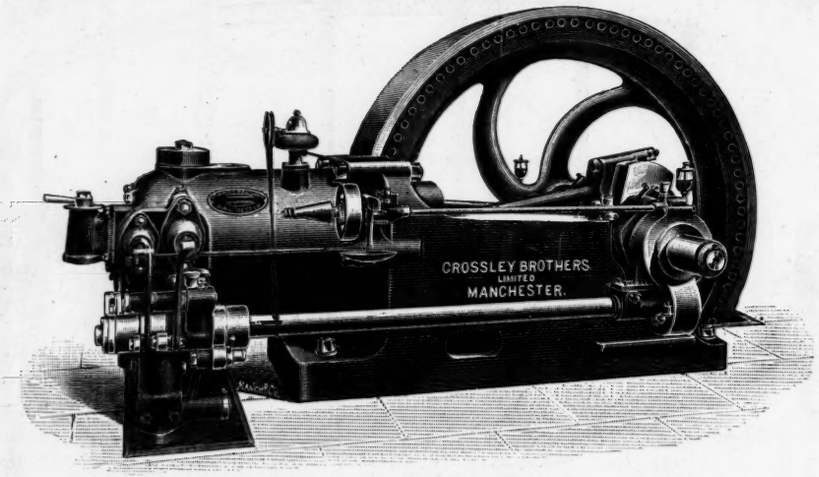

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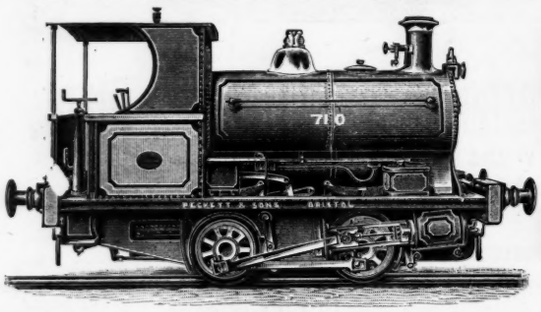

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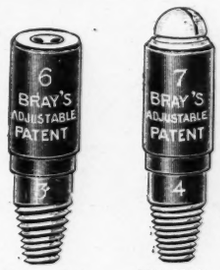

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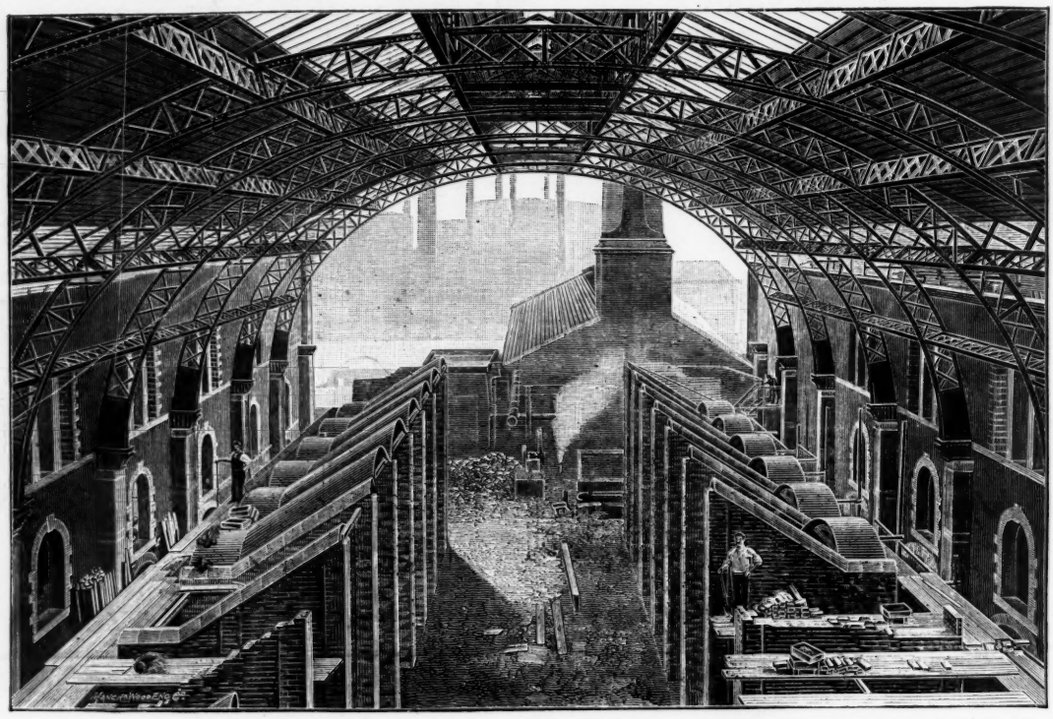

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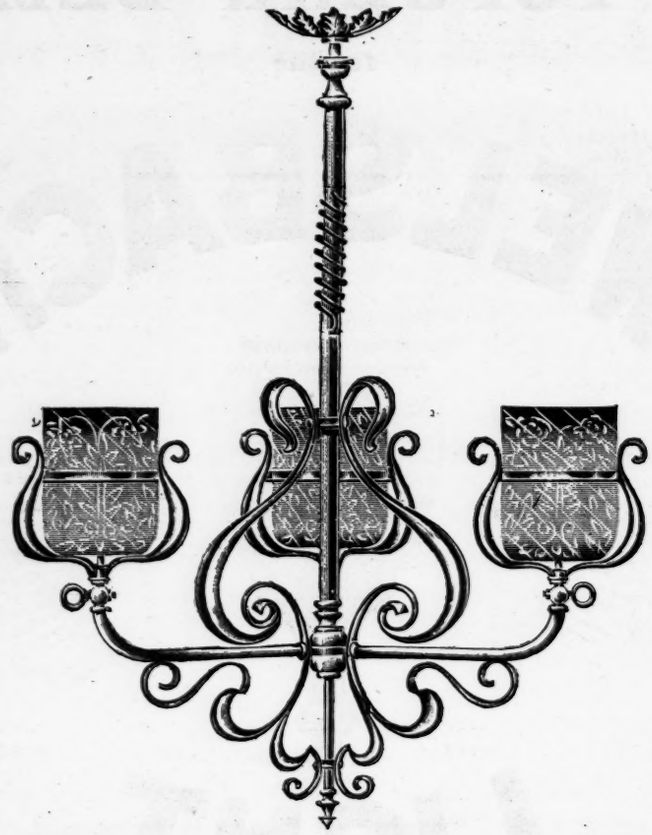

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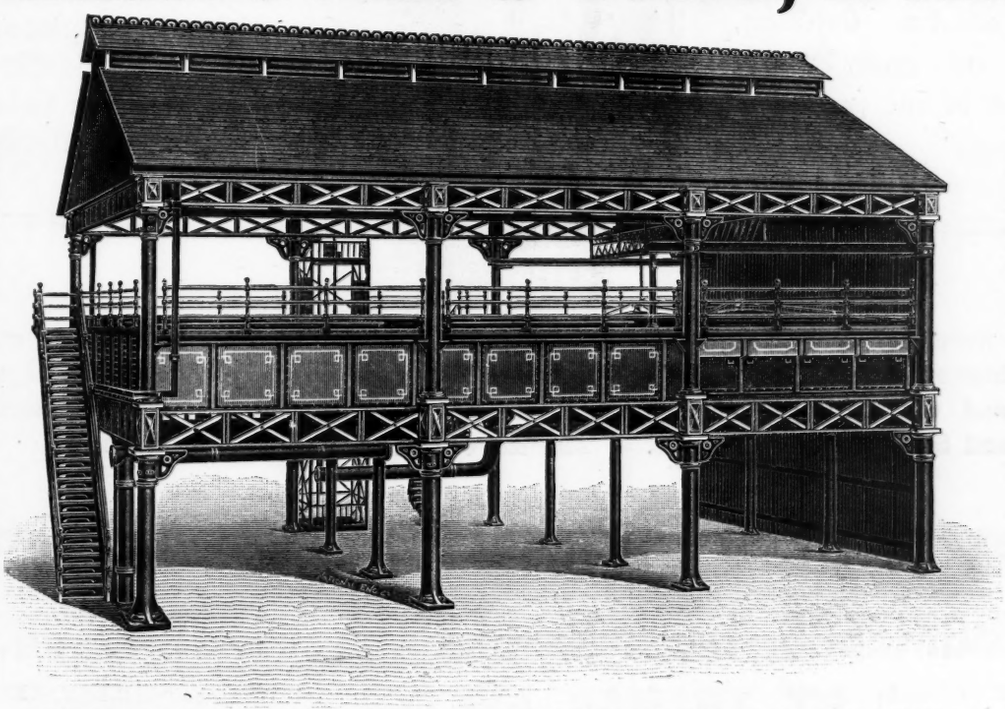

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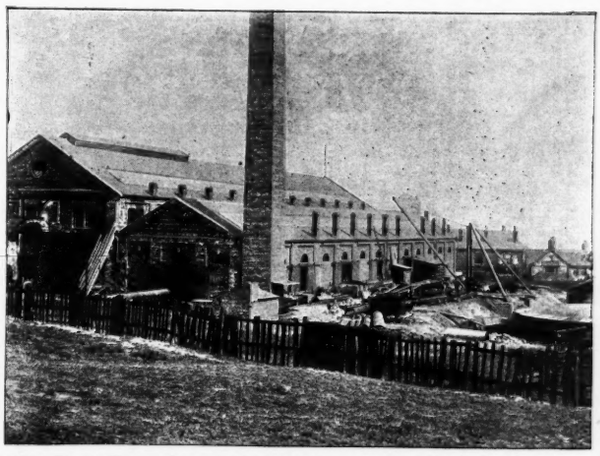

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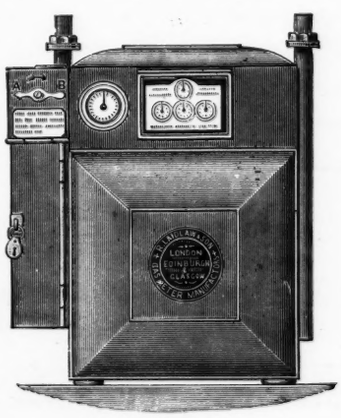

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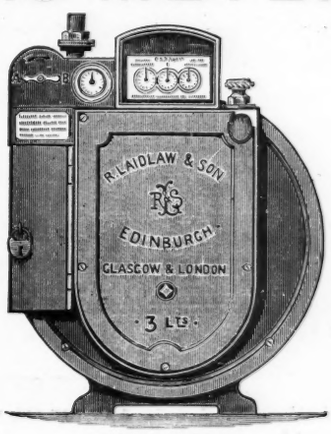

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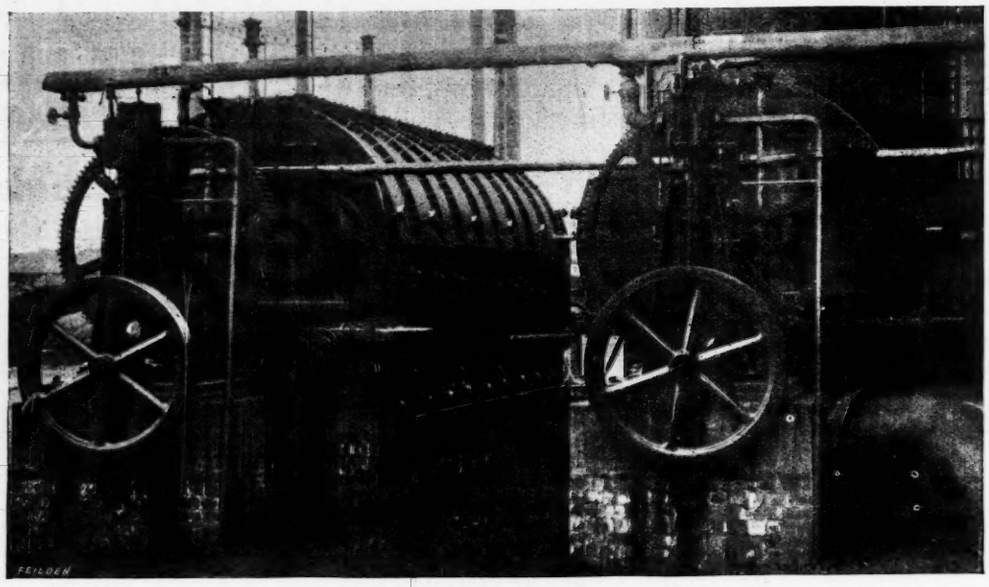

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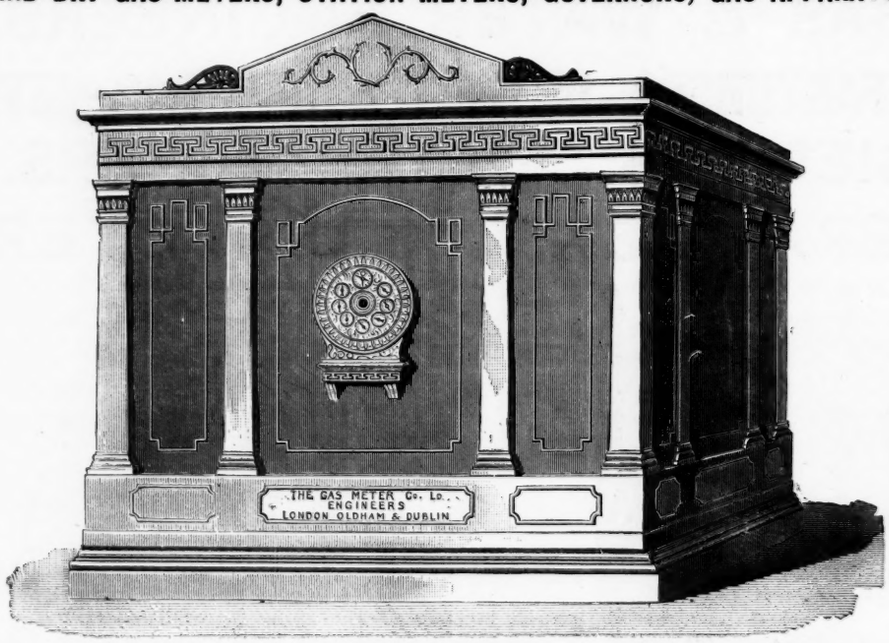

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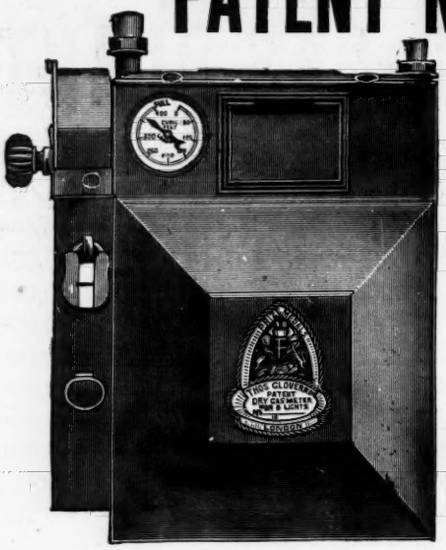

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[See also Advt. on last White Page.

CONTENTS.

EDITORIAL NOTES:—

GAS, LIGHTING, &c.— PAGE.

Some Three-Year Coal Contracts 1071
The City Conference on the London Gas Question 1071
The Prospects of Alcohol Lighting 1072
Gas from Sewage Sludge 1072
The Report on the City and Guilds of London Examinations. . 1072
The Barking Gasholder Disaster 1073
A Seamy Side of Municipal Trading 1073
Lord Rosebery on the London Borough Elections 1073

ESSAYS, COMMENTARIES, AND REVIEWS:—

Gas and Water Companies in the Stock Market 1074
Electric Lighting Memoranda 1074
Incandescent Gas Mantle Competition. 1075
Violle on Contemporary Photometry 1076
The Investor's Opportunity 1077
The Work of the Examinations Department of the City and Guilds of London Institute 1078
Water Acts for 1900 1078

THE INTERNATIONAL GAS CONGRESS IN PARIS:—

Papers Read (*Continued*)—
Thermic Reactions in the Distillation of Coal. By M. Euchéne 1080
Gas Lighting in the Champ-de-Mars and Trocadero, Paris. By M. Auguste Lévy, of Paris 1084

TECHNICAL RECORD:—

American Gaslight Association—Annual Meeting at Denver, Colorado—Inaugural Address of Mr. George G. Ramsdell, of Philadelphia 1087
Boiler Trials and Analyses of Fuel and Chimney Gases . . . 1090

REGISTER OF PATENTS:—

Electric Lighter for Incandescent Street-Lamps—Duncan, J. H. H., the New Sunlight Incandescent Company, Limited, and Barnett, H. T. 1093
Gas-Meters—Jensen, H. 1093
Conveyors for Hot Coke—Graham, M.. 1094
Substances for Impregnating Incandescent Mantles—Pink, L., and the Vulkan Gesellschaft für Selbstzündende Glühkörper, mit Beschrankter Haftung 1094
Suspension Lamps, Chandeliers, &c.—Kemp, C. W. (Fahndrich, W.) 1094
Manufacture of Water Gas—Slocum, F. L. 1094
Patent Notices 1095

CORRESPONDENCE:—

Illuminating Gas from Sewage Sludge, and the Coalowners' Combination 1095

LEGAL INTELLIGENCE:—

Sugg and Co., Limited, *v.* Somzee-Greyson Gas-Light Syndicate 1095
In re the Coventry Gas-Fitting Company 1095
A Claim by the Bexhill Water and Gas Company 1096
Tampering with Gas-Pipes 1096

MISCELLANEOUS:—

Fatal Accident at the Sheffield Gas-Works—Two Men Buried in a Coal-Shoot 1096
The Wreck of the Barking Holder 1097
London Local Authorities and the Price of Gas—Motions to be Submitted at the Guildhall Conference 1098
Capital Requirements of the Welsbach Company—Preference Stockholders Object, but the Proposals are Carried 1098
Meeting of the Oil Gas Enrichment Company, Limited . . . 1099
Launceston Town Council and the Gas Company 1099
Sales of Shares and Stock 1099
Electric Lighting Notes 1100
Notes from Scotland 1101
Current Sales of Gas Products 1103
Coal Trade Reports 1103

PARAGRAPHS:—

OBITUARY: Mr. William Porteous. 1079
PERSONAL: Mr. J. W. Turner; Mr. Sydney E. Stevenson; Mr. P. M'Dougal; Mr. J. O. Whitaker; Mr. J. A. Coombs . . . 1079
Composition of the Air of Paris—An Iron and Cement Reservoir—Natural Gas in America 1079
Paris Gas Company—Fatality at the Beckton Gas-Works . . . 1093
Bangor (Co. Down) in Darkness. 1095
The Projected New Water-Works for Rugby 1096
York Streets in Darkness. 1099
The Proposed New Gas-Works for Coventry—Proposed Purchase of the Devonport Gas-Works by the Corporation—Honiton Water Supply—Gas at the Brewers' Exhibition 1104
The Penny-in-the-Slot System at Gateshead—Additional Capital for the Maidstone Gas Company—The Recent Shipment of American Gas Coal to the Thames—Conditions of Labour and Rate of Wages for Gas Stokers at West Hartlepool—The Proposed Municipal Colliery for Bradford—Gas Explosion at the Paris Exhibition—A Parish Council's Gas Supply Cut Off—Additional Storage at the Chesterfield Gas-Works—Illuminating Gas from Sewage Sludge 1105
Gas-Works Extensions at Ripon—Adoption of Gas Lighting at Barnton (Cheshire)—Gas Poisoning in a Weaving-Shed—Carlisle Gas-Works Extensions 1106

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EDITORIAL NOTES.

Some Three-Year Coal Contracts.

THE publication of the details of several considerable contracts for Durham gas coal that have been recently completed, has been hailed in some quarters as affording very hopeful signs for the future. We can only say that if the prices at which these contracts have been closed really represented the probabilities of the situation for the next three years (the term for which they run), the outlook would be very dark for the gas industry. The contracts in question, made by the Paris, Lisbon, and Catalonia Gas-Works, provide for the delivery of 310,000 tons of gas coal during each of the next three years at prices averaging 13s. 5d. per ton f.o.b. Tyne. Seeing that the f.o.b. price of Durham coal was not so long ago, and is, in all except abnormal times, something from 6s. 6d. to 7s. a ton, and that the price at which the London Gas Companies have been compelled to buy in this present year of little grace on the part of the coalowners did not go higher than about 16s. 6d.—a figure that has sufficed to send gas up 6d. to 7d. per 1000 cubic feet—the prospect of paying 13s. 5d. a ton for three years would not be hailed with delight by the English Gas Companies.

We have not the slightest hesitation in saying that no such prospect lies before the gas consumers of the country, and that the Durham colliery proprietors have been extremely fortunate in finding purchasers willing to commit themselves to such engagements as those instanced. The signs of the times are much more favourable to the gas-coal buyer than those afforded by the selling of 930,000 tons at over 13s. a ton. Everything points to a considerable quieting-down of the market and a steady sinking of prices towards their former level. The miners' strike in America is now practically over; and on every hand orders are heard of that formerly came from other countries to the English coal market going to the United States. As we have frequently pointed out, it is not to an influx of American coal into England that we can look for relief to the present state of the coal market in this country and in Europe, but to the competition of such coal with that from English ports in the markets we at present serve.

In the iron trade, too, the effects of the competition of American goods in both our home and foreign markets are being increasingly felt; and the longer coal prices are maintained at their prevailing level, the harder will it be for English manufacturers to successfully contend against that competition. A great hubbub is being raised in some quarters over South African firms sending their machinery orders to the States instead of to this country; but surely the blame does not lie with the South Africans. They want machinery, want it as cheaply as they can buy it, and want it quickly. The American manufacturer is ready to supply it more speedily and at a lower price than the English. Then it seems to us that the orders will naturally go to the States, and that what the English maker has to do is not to lift up his voice and cry aloud for favoured treatment, but to find out why his American competitor can beat him, and then set to work to get on an equality once more. A touch of competition is a splendid tonic for any industry. Before, however, the English factory can get on terms with the American, coal will be down to half the 1900 price. The descent has now begun. But, unfortunately, at present coke is descending with even greater rapidity.

The City Conference on the London Gas Question.

TO-MORROW the Lord Mayor of London is to preside over a conference called by the Corporation to consider the London Gas Supply. This is the second gathering of the kind; and it remains to be seen whether the corporate wisdom of the old Common Council of the City will deal with this thorny subject more adeptly than the London County Council did, as reported in last week's "JOURNAL." On that occasion, when the Chairman had fired off his carefully prepared address, nobody knew what to do next. To-morrow things will not be left to chance and Sir Albert Rollit; an *agenda* of six Notices of Motion having been prepared and circulated in advance. The London County Council must feel slightly mortified over the reflection that they were not so businesslike. As we give the text of the notices elsewhere, it is unnecessary to repeat them here. The organic resolutions are the first and the second. The

first declares in general terms that "Parliament should "intervene to protect gas consumers from the evil effects "of the giant monopoly brought about by the Gas Acts of "1847 and 1860;" and the second suggests that the price of gas in London should be that charged for the cheapest supply furnished for the time being by any Company, "so "that gas consumers should not be compelled, as under "the present monopoly, to make good the loss incurred "by bad management." These resolutions are very much to the point, and have the merit of registering what is unquestionably the sense of public opinion upon the matter. Their adoption by a representative congress of City and Metropolitan Local Authorities will constitute a serious aggravation of the long-standing difficulties of the higher-priced London Companies.

It is not the least serious and significant feature of this pronouncement that it goes away back behind the sliding-scale settlement of 1875-6, and fixes the root of the grievance complained of by the public in the legislation of 1847 and 1860. This is a "far cry;" but it is no small relief to get the controversy cut adrift from the sliding-scale settlement. Rightly or wrongly, this settlement is thereby made to appear an incident, and not a starting-point. Legally speaking, this is what the sliding-scale is; because it is no general enactment, like the Acts now in question. If the prices of gas in London had been open to reasonable explanation, on the merits, this resurrection of the organic statutes would never have occurred. As matters stand, however, some such arraignment of the Acts of Parliament under which the existing state of things has come to pass was to be expected. There is no denying the facts; the trouble is how to deal with them. We cannot but unaffectedly regret that circumstances have had this issue, while confessing that the effect is a natural and logical result of the cause. None but the wilfully or incurably blind could fail to see the peril to the whole statutory gas industry of the United Kingdom which lay in the unequal—the largely unequal—gas prices levied by the London Gas Companies on whom Parliament had conferred privileges and laid obligations as nearly identical as possible. Now the peril has become an emergency; and it is only too clearly to be feared that, before all is done and a new settlement arrived at, the innocent and the culpable will be made to suffer together. What parliamentary action has brought about, Parliament can be moved to remedy. In the question once more at issue, the Corporation of London are true to their traditions in looking to commercial competition as furnishing the key to efficient service. Actual competition in gas supply being out of the question, the Corporation seek to obtain its usual and ordinary result—the levelling-down of prices—by fresh statutory enactment.

The Prospects of Alcohol Lighting.

As an amusing illustration of how little substantial aid from facts is required to lift the "popular science" writer upon a comfortable hobby, which will forthwith amble away with him into the Unknown, we draw our readers' attention to something appearing in "Leisure Hour" on the subject of "Alcohol for Lighting Purposes." It is here observed that the illumination of the "Orangerie" in the Tuileries Gardens by means of the alcohol-burning lamps invented by M. Louis Denayrouze, "together with the results now "obtained at the Pont de Jéna and elsewhere by the same "system of lighting," seem to indicate that alcohol will be one of the chief illuminating agencies of the near future. Without entering into details that would be too technical for the reader—and probably for the writer—the latter confesses himself unable to explain precisely how it is that M. Denayrouze has been able to render alcohol "a light-"giving agency of extraordinary brilliancy;" but details, of course, are immaterial. It is far more interesting to picture the possible consequences to agricultural interests of the general adoption of this method of lighting—"all alcohol being of vegetable origin." In France, for example, where agriculture languishes "for reasons of an "economic and fiscal order," a largely increased demand for crops which are suitable to the distillation of cheap alcohol would bring an important amelioration to the condition of the peasantry in many districts, "and go far to "solve the perplexing question of protecting the French "wheat-grower from foreign competition." This is racy of the soil. How the manufacture of cheap alcohol from potatoes is to help the wheat-grower is another detail; but let it pass. We are next bidden to ponder the possibility that "one of the great changes of the new century may "be that the vegetable kingdom will take the place now "occupied by the mineral kingdom in the production of "artificial light; in other words, that coal gas and petro-"leum will be both succeeded by alcohol." Even the electric light may be put out of fashion by the same competitor "on account of its costliness"—as if cost ever had anything to do with the waxing or waning of a fashion—and then, naturally, both metallurgists and mechanicians would suffer a diminution of their trade. All this is very pretty cobweb-spinning, out of the slenderest of structural materials. Unfortunately, or fortunately, as one may look at it, any kind of alcohol light will have a good deal of leeway to make up before it can get on level terms with the existing illuminants; and then it will not be the French agriculturist who will reap the benefit of it. Meanwhile, the gas industry can afford to wish well to the alcohol light, or to anything else which will take some of the pressure off the coalfields.

Gas from Sewage Sludge.

THE letter of Mr. Edward A. Harman, of Huddersfield, on the use of sewage sludge for the manufacture of illuminating gas, which appears in our "Correspondence" column to-day, is a reminder that it is at least as feasible to make gas out of this waste material as it is to drive dynamos by burning town's refuse. Beyond this, we fear there is not much to be said for the performance. Of course, if local authorities owning gas-works choose to require the gas manager to get rid of their sewage sludge by carbonizing it, that is their affair. It can be done, at a price; but it is not good business. Clean, dry gas coal is the best raw material for gas manufacture; and it is a very costly blunder to suppose that there is ordinarily any surplusage of heat in gas-retorts to be played with in the fashion described by Mr. Harman. On the contrary, the getting up of sufficient heat where it is wanted, and maintaining it at the lowest possible expense for fuel and repairs, is quite enough responsibility for most gas-works' managers and carbonizing foremen. A good retort-setting is too costly and delicate a piece of apparatus to use for burning or carbonizing sewage or any such worthless rubbish. Nothing of the kind should ever be permitted to enter a gas-works. It may be, as Mr. Harman says, that "the cost of destruction (of sludge), including labour, "fuel, and capital charges, is in some towns enormous." That is no affair of the gas manager. He should allow his good colleague the cleansing superintendent, or his friend the electrical engineer, to see to all that. There is no reason whatever why he should upset his carbonizing plant, and ruin the aspect of his fuel account, to conceal the cost of the sewage system. Once let a disturbing element such as this get into carbonizing accounts, and the gas manager will never know where he is. Mr. Harman's affection for sewage sludge, and his amiability in trying to make gas with it, will not be shared by many of his brother professionals. Let us leave it to the electricians, by all means. If they can burn it, the relief to the coal market will be as great as if it were carbonized; and nobody will begrudge them a full supply of this interesting preparation. They can have all the marsh gas to be had from "septic "tanks" too, if they like it. The new-fashioned septic tank is only the old tight cesspool with a fine name; and it is no fresh discovery that this receptacle made gas. Many a man has been reminded of the circumstance disagreeably, on entering one with a naked light.

The Report on the City and Guilds of London Examinations.

THE report on the work of the Examinations Department of the City and Guilds of London Institute has been published. The Committee mention, with pardonable pride, the success of their exhibit at the Paris Exhibition, which received a "Grand Prix" at the hands of the International Jury. Various references in the body of the report testify to the consciousness of the Committee of the shortcomings of their methods, and their desire for improvement, especially as regards adapting instruction and examinations to the needs of the trades and the requirements of learners. The subject of gas manufacture is one of those which are under the consideration of the Committee. The time of the examination has been extended, to enable candidates to do their work less hurriedly. It does not appear from the remarks of Dr. H. G. Colman that he is particularly impressed with the quality of the candidates, more especially in the ordinary

grade. This seems to argue bad or insufficient instruction, or failure to get the right stamp of candidate. Through almost all the Examiners' reports there runs the same line of criticism, which points to the probability that the Institute is not getting at the right order of learners. Many candidates for all sorts of examinations are clearly certificate-hunters, whose object is to equip themselves with as many of these fallacious testimonials as they can obtain by "getting up the subject." They probably belong to the great *genus* "pupil teacher." Over and over again the Examiners complain that the real workmen entirely fail to show an intelligent appreciation of the science of their craft, other candidates who are good at the paper-work "are complete failures as workmen." It strikes one also, while reading these reports, that the elementary education of the candidates must be very poor. They supply one more proof of the miscarriage of the Board School system of the country. The sketching of the candidates is almost without exception condemned. Even in the somewhat elevated regions where telegraphy and telephony are cultivated, "the making of even the simplest sketches shows, "generally, lamentable incompetency." After this, it is not surprising that the humble plumbers betrayed "a frequent "failure to understand the meanings of views, elevations, "plans, and sections." There is something rotten here.

So far as instruction in the elements of gas manufacture are concerned, the record does not compare favouralby with the American work to this purpose inaugurated by Mr. Walton Clark, of Philadelphia. The City and Guilds of London must try and get rid of the text-book student, and endeavour to lay hold of the real workman. It is only necessary to read the report of the Examiner in such a fundamental handicraft as carpentry and joinery to perceive that the scheme of examinations is often out of focus. As might be expected, some trades are better fitted for this scheme than others. The prize paper in goldsmiths' work, for instance, is characterized as being of "signal excellence, and the practical work submitted with "it is one of the best which has been presented." This is comforting, although the subject is not one in which we are specially interested. Generally speaking, however, the impression created by a perusal of the Examiners' reports is not very favourable to the system as a whole, nor encouraging of any hope that the great mass of workmen are being leavened or touched by it. How can one judge differently while the statistics remain what they are? Battersea Polytechnic—"Gas Manufacture"—ten students registered, seven examinees, one pass. Borough Polytechnic, one candidate—no pass. The Regent Street Polytechnic seems to be the greatest school of gas manufacture in London, with 35 students, 25 examinees, and 10 passes, whereof three are prizemen. This is not a bad record for one centre. At the same centre electric lighting claimed 63 students, of whom 25 became candidates, and 10 passed. Ninety-three plumbers turned out 24 passmen. Unhappily, in nearly all the Examiners' reports, the most searching questions, those which went to the heart of the practical or commercial part of the craft, were those which generally "floored" the candidates, and are reponsible for the heavy proportion of failures.

The Barking Gasholder Disaster.

In our "Miscellaneous News" columns, is told the story of the serious misfortune which has overtaken the Barking Gas Company in the collapse of their cable-guided holder. Engineers will miss one important point from the narrative, and that is any mention of the actual cause of the accident. The information which we possess is not sufficiently precise to warrant even an expression of opinion in this regard; and, as there may be some question between the contractors for the holder and the Company, it is not prudent for anyone who might throw light on the matter to commit himself at this stage. But we shall no doubt learn the truth in due season. Meanwhile, we would ask readers to withhold their judgment, and not to condemn the cable system of guiding as a system until the matter has been fully investigated. The system itself has in several instances proved to be, according to engineers whose word is beyond question, all that could be desired; and some satisfactory explanation of the present occurrence may be forthcoming. A serious feature of this altogether unfortunate event is that the holder (excepting a small one with a capacity of only 14,000 cubic feet) constitutes the entire gas storage of the works, which have an output of from 130,000 to 140,000 cubic feet per day; and consequently, had the Company not been able to obtain the friendly aid of the Ilford Gas Company, the position of the Manager (Mr. W. B. Reidie) would have been a desperate one. This brings to mind the old adage about "carrying all one's eggs in one basket;" and it is a question which should be gravely considered whether in a works having only one holder, when making an extension of storage, prudence should not outweigh the large saving which can admittedly be effected by telescoping. In a second holder, there is a great safety to compensate for the additional expenditure; it is an insurance against an interruption of constant supply, and loss and damage to business in the event of an accident. Telescoping may come after the second holder, when extended business demands it. This is a suggestion which presents itself in connection with the Barking *contretemps*. But many managers of limited sized works will count the cost; and some will shake their heads. For them we hope the future has not a rude awakening in store.

A Seamy Side of Municipal Trading.

It was certain to come out; and now it is out there can be no objection to rubbing the truth well in to those who have hitherto ignored the possibility. We refer to the exposure of a seamy side of London County Council Progressivism at last Tuesday's meeting of this body. "Mr. Beachcroft "referred to a letter sent to the Council by the Secretary "of the Municipal Tramways Officials' Association, in "which it was stated that Mr. Benn (Chairman of the "Highways Committee) had informed a deputation that "the question of including employees in the superannua-"tion scheme of the Council should be brought forward "after the election. Electoral assistance was promised "in the letter from members of the Association to those "councillors who supported the Association in the matter "of superannuation. . . Mr. H. P. Harris hoped the "tramway question would not be made an electioneering "one. He held in his hand a bill issued during the recent "General Election asking electors to 'Vote for Benn, who "'voted for and secured a ten-hours day, one day's rest "'in seven, and better wages.'" Thus runs the report of the debate. We hope Mr. Priestman, of Bradford, and other admirers of the theory of municipal trading, will pay heed to this disclosure of how the thing works in practical politics. Theories of government action are lovely to talk about, and possess an unfading attraction for some minds. Others prefer to see what is done, behind the backs of the talkers. It may not be easy to find plausible hypothetical objections to the principle of municipal trading so attractive as the pleas urged by well-meaning gentlemen like Mr. Priestman in its favour. But when it comes to the working, the force of argument is all the other way. One of the strongest points of the opposition case was very well put the other day at Leeds, by Mr. Whittaker, of Southampton. He asserted that if municipalities are to extend their trading enterprises, it will be impossible for them to get councillors to devote the necessary time and care to the work of administration without some remuneration. The right men simply cannot afford to give up their own interests in order to carry on commercial enterprises which do not belong to them. Another objection is that so pointedly brought out at the London County Council meeting. It will be impossible to prevent municipal busybodies from attempting to make political capital for themselves out of everything which appears to be popular in the working of the authorities to which they belong. They may be only as flies on the wheel; the advertisement will be sought all the same. And this influence will become a canker, fretting through the whole texture of municipal and political affairs. If municipal trading is to be carried further, it will become necessary to put the administration of the various enterprises into commission, if only in the best interests of the councillors themselves.

Lord Rosebery on the London Borough Elections.

A rooted disinclination to look facts in the face, coupled naturally with a fixed determination to take words for things, appears to be the dominant "Note," to use a current term, of that otherwise unintelligible chorus of conflicting election cries which is called the profession of Progressive opinions. Lord Rosebery spoke on Friday last on the subject of the London borough elections; and, as usual, he uttered some counsels of sound common sense.

He bade a not very mournful farewell to the departing Vestries, and hailed the advent of the new authorities without much enthusiasm. On the all-important question of whom to elect to membership of the new borough councils, Lord Rosebery urged that selection should be made not of those men who desired to serve themselves, but of those who were willing to serve the public. He went on to advise that choice should be made, wherever possible, of business men, not men who would simply use the Council as a debating society, with a view to practising for Parliament. Uncorrupt men—men with a single eye to the public service—are the men for placing upon a local authority. This declaration, of course, was pounced upon by certain newspapers next morning as meaning that the electors should vote Progressive; for where else is virtue to be found? This reminds us of what we remarked last week about the haloes that are now being furbished up for these worthy gentlemen by their journalistic supporters. Some new ones will be wanted, to replace others lost during the General Election. Lord Rosebery suggested that the question of the housing of the people should be put to candidates in the most personal fashion possible, by asking every man if he is a builder, or owner of any house property in London; and, if so, where it is situated, and what it is like. This is getting to the facts, indeed; but Lord Rosebery did not stop here. He actually ventured to remind his hearers that large powers for dealing with housing questions already exist, but are not exercised in the vast majority of cases.

Obviously, his Lordship is no Progressive. He has too much regard for facts to be a Socialist; and too great respect for the work of Parliament to patiently abide the ascription to the Legislature of all the blame properly due to local apathy and conflicting interests. And, once more, everything that Lord Rosebery said ought to be done was promptly appropriated for the advertisement of a party in local politics. Nobody else is allowed to have a spark of public spirit. For instance, the question of the equalization of rates over the Metropolitan area is being discussed somewhat acutely in the richer boroughs; and this is held up as a matter of objecting to the help of the poor out of the pockets of the wealthy. But from what has lately been stated in these columns, the most extravagant of all the Metropolitan Local Authorities are those of the poorest districts. What chance is there of reforming them if they are able to draw upon their richer and more prudent neighbours? This idea of the equalization of rates is precisely one of those things that will not bear examination below the surface. Imagine Birmingham, Leicester, Nottingham, and Norwich clustered together with conterminous borders. How would the ratepayers of any one of these places like to be made liable for the mistakes and wastefulness of the others? Yet that is no more than the condition sought to be set up for the regulation of the finances of 28 Metropolitan Borough Councils. Unless the operation is conducted with the nicest care, the equalization of the rates for any group of local authorities is calculated to destroy the very soul of local self-government, which is financial responsibility. In London, at any rate, it is only too probable that the owners of heavily-rated property would fare worse under the supposed improved system of local government than under the Vestries, if these bigger bodies could rely upon being subsidized by one another to an unlimited extent.

Mr. Alexander Young, Manager of the works in Edinburgh of Messrs. R. Laidlaw and Son, has been presented by the employees of the firm with a handsome dining-room clock and hall barometer, on the occasion of his marriage.

At the meeting of the London Section of the Society of Chemical Industry on Monday, Dec. 3, Mr. W. J. Dibdin, F.I.C., F.C.S., formerly Chemist and Superintending Gas Examiner to the London County Council, will read a paper on "The Effect of Quality on the Consumption of Coal Gas."

The coal-tar derivative fuchsine is generally supposed to owe its name to the fuchsia, as its tint certainly resembles the colour of that flower; but this, according to the "Engineer," is not the case. The inventor of fuchsine, whose death was lately recorded—M. Francisque Renard—and his brother desired to identify their name with the new product; but, not liking to adopt the appellation of renardine, they translated their family name Renard (fox) into the German Fuchs.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

Subject to what we shall have to say later on regarding the special department of Gas and Water, business on the Stock Exchange last week showed in most of the markets a rather more active disposition than it had in the preceding week. But things never became absolutely brisk; and the preparations to receive the C.I.V. on Saturday practically truncated the week of a day. However, the tendency in values was on the whole favourable; and several quotations made a modest advance. But Consols and the War Loan are down, though the closing prices were better than the worst of the week. The settlement was not heavy, and revealed no particular feature. The Money Market was extremely easy, and short loans were negotiable at light rates; but discount terms closed tighter. In the Gas Market, there was almost a dead calm; and the week was one of the most barren it has ever been our lot to record. On Monday and Tuesday, transactions amounted to just about the average of an ordinarily quiet day; but thenceforward something like absolute stagnation set in, and lasted to the close. The quietude may be realized when we say that, on the last four days of the week, the aggregate of the bargains marked did not amount to a score. Only one change in quotation was effected—viz., in Gaslight ordinary, which opened rather weaker on Monday, and fell a point. Par was marked once on the opening day, but was not again touched; and the lowest figure was a "special" deal at 98. The secured issues, so far as one could judge, seemed inclined to be firm. South Metropolitan marked top price—132—on the opening day, but could not do it again. In Commercials, only one transaction in the debenture was marked. The tendency in the Suburban and Provincial group could not be gauged. The few dealings recorded in the Continental Companies were indicative of steadiness, at average middle figures. Among the remoter undertakings, there was perhaps almost as much business as elsewhere; River Plate being the most noticeable in this respect. In the Water Companies, business was much reduced, even below the normal point of quietude; and very few alterations were made in the old quotations. But the tendency was firm; and changes were all upward.

The daily operations (or the lack of them) call for no detailed report, nor the publication of the table. On Monday, Gaslight ordinary fell 1. On Wednesday, Southwark ordinary rose 2. On Thursday, Southwark "D" gained 3, and West Middlesex 2½.

ELECTRIC LIGHTING MEMORANDA.

Small Electricity Supply Undertakings—Mr. Vesey Brown's Views—Small Works a Bar to Progress—Duty of the Local Government Board.

The subject of small, isolated electricity supply undertakings, usually belonging to local authorities, is of perennial interest for the electrical engineering profession. Mr. C. S. Vesey Brown, the City Electrical Engineer of Lincoln, is in particular much exercised in mind by various aspects of this subject; and having already read a paper upon it in the summer, at Huddersfield, he has just written an article bearing the same title for our excellent contemporary the "Electrician." Mr. Brown has taken note of the circumstance that most of the later Electric Lighting Provisional Orders issued relate to the supply of small places, sometimes with as low a population as 3500. He shakes his head over the prospect of the kind of electrical supply work likely to be done under such of these Orders as may be acted upon. He sees all these twopenny-halfpenny undertakings designed specially for their owners; or at least without any regard to the desirability of standardizing generally, or of preserving some sort of similarity between neighbouring installations. He hints at the conclusion that, under these conditions, the small independent electricity supply installation is likely to prove a nuisance—unsatisfactory in itself, and a hindrance to the improvement of the general system by the establishment of central supply works for large districts. So it has at length come to this, that the industrious electrical tout, who has been largely instrumental in persuading the small local authorities of the United Kingdom to go in for their own electric lighting for the sake of "Progress," is being cursed by his more reputable professional brethren for blocking the way to real progress in the direction of bringing the cheapest possible electricity into service of the community as a whole.

This is very solacious for us, who have denounced the proceedings of the electrical tout these many years, and have been regarded coldly by the electrical journals, to say the least of it, on this account. We have never been able to see any "Progress" in the saddling of local government districts with isolated electric lighting schemes that could never do anything else than sell a wretched article at a high price, nor ever make both ends meet at that. Of course, all this prudence has been ascribed to trade jealousy. But the truth is now beginning to make itself heard; and even electricians are fain to urge that this business of setting up insolvent electricity supply undertakings by ill-advised local authorities has been sadly overdone. This is how Mr. Brown now sees it. He says: "It would be interesting to know whether the Board of Trade and Local Government Board have sufficiently investigated the position of . . . local authorities to see whether, before granting statutory powers for electric lighting,

the systems for drainage and disposal of sewage are adequate to the needs of the town or district; if sufficient has been done to properly metal and pave the roads and footpaths under the local authorities' jurisdiction; if efficient accommodation is made for infectious diseases beyond that provided by the poor-law authorities; or, again, is the water supply all that it should be; and many points of far more importance to the welfare of the people than the question of being in possession of a monopoly for the supply of electricity." So Saul has joined the prophets once more; inasmuch as Mr. Brown, who very reasonably sets forth these objections to the fruition of electrical touting, will find the same thing advanced in these columns over and over again.

The humour of the matter lies in the discovery, somewhat belated, that this particular kind of electrical progress—for it will not be denied that the very number of applications for Provisional Orders has been so regarded, irrespective of the merits—constitutes a hindrance to the real thing. Mr. Brown believes that the promiscuous granting of Provisional Orders has been detrimental to the British electrical industry; and this result has been produced irrespectively of whether the Orders have been carried out or allowed to rest in abeyance. This is undoubtedly true; but we like to have it acknowledged by an electrician. The parochializing of electricity supply was a mistake. Mr. Brown mourns over it, and thinks the evil irreparable, but nevertheless declares it to be his firm opinion that "if each town and district was originally made the owner of the right to supply electricity, and given (say) five years in which to make up its mind to supply under statutory powers, and if nothing was done to carry out these obligations to transfer the concession, either by auction or some equally convincing means, there is not a town or district in this country which would not be operating an electricity works to-day." This conclusion is a *non sequitur*. Like the "Electrician," moreover, which discusses the matter editorially, the lesson which experience of the dealings of local authorities with this matter teaches us is not that of the desirability of putting these bodies in the advantageous position proposed by Mr. Brown. Unlike our contemporary, however, we can claim to have foreseen long ago that the past and present tendency to force every little local authority to go into the electricity supply business was to be deprecated.

Of course, the question is a difficult and a complicated one. Now that electricity supply in bulk is looming upon the industrial horizon, the interests that are concentrated upon this new development naturally think the small statutory undertaking a block and a nuisance. Their opinion is not influenced by any consideration of what the undertaking may be in itself, as regards its proprietors and supporters. The more prosperous it is, indeed, the greater the hindrance it offers to would-be supplanters. On the other hand, it is not so long ago that there was no prospect of such a thing as cheap electricity supply in bulk; and districts had to face the alternative of a local undertaking or no electricity. Then, in addition, there is the personal business element to be considered. Is the "consulting electrician," with himself to look after in the first place, to sacrifice his chance of a job out of regard for considerations which, in his case, would amount to pure philanthropy? Our contemporary asserts that "it is the duty of the consultant to see that those he is advising are at the outset presented with a clear statement of the true character of the problem and its best solution." Alas! who in this case is to pay the consultant? For if he were to tell the truth as he knows it, nine jobs out of ten would never come off. All the same, the local authority could obtain their Provisional Order and play "dog in the manger." After all is said, therefore, it comes to this, that the Local Government Board ought to keep small local authorities from embroiling themselves with electricians, when their circumstances are such as to clearly indicate the advisability of husbanding their resources.

INCANDESCENT GAS MANTLE COMPETITION.

A JOURNALIST'S portion is not always a happy one, particularly if it lies in the channels in which run class or trade interests. It is his duty to chronicle, and if need be to comment upon, without fear or favour, everything he hears and everything he sees which, in his view, has any interest, from a professional, trading, or business standpoint, for the whole or any section of his readers. But in doing this—in carrying out his duties on broad lines, without favouritism, and with a singleness of purpose—he frequently, while giving pleasure on the one hand incites displeasure on the other; and occasionally he receives (sometimes directly, sometimes indirectly) evidence of petty jealousy and animosity, and even of obloquy. But the true journalist is not impressed, affected, or shaken by any such considerations. His duty is to be just, and to give the best he can command, and the fullest information he can obtain, to those who look upon him as a repository for, and collector of, intelligence of every kind touching their particular interests. The "JOURNAL" has always endeavoured to maintain a high standing in this respect. One and all who have had anything worth calling attention to have never been, and never will be, refused a hearing, or the publicity they desire; and the question of incurring the wrath of others has never, and never will, trouble our minds. And we are happy to acknowledge that we have been comparatively free from unwarranted aspersion, and that there have been few indications of our having incurred resentment through our freedom of action. It can be well understood that among manufacturers and vendors of articles in the same line there would be a little latent jealousy when a competitor in business brings out something new, or a fresh aspirant enters the field, and the one or other succeeds, by proving the worthiness of his goods, in getting the helping editorial push. But that jealousy has, in most cases, remained latent so far as we are concerned. All that is new and meritorious, and all that will promote the welfare of the industry we serve, has entrance to these columns.

The question may be asked, "Why have you written thus in introducing a little information which you have to give on the subject mentioned in the title?" The reply is simply this: A few weeks since we heard in the City that competition in the sale of incandescent mantles was shortly to be seriously entered upon, and then the legal monopoly which the Welsbach-Sunlight combination possess, or have so far succeeded in holding, would again be strenuously disputed, if action by the Welsbach Company compelled. We made inquiry, and found there was some truth in what we had heard; but our information does not go far. In the course of the inquiries, it was apparent to us that there was a little feeling that the "JOURNAL" was somewhat favourably inclined towards the Welsbach Company; and the inference we are left to draw (so much, however, it is only fair to say, was not expressed in words) is that we should be reluctant to fairly and freely disseminate information about promising competitors. We can find nothing in our past action which can uphold that idea. It is not for us to do anything to discourage or to try to prevent competition in incandescent mantles; that is the business of the Welsbach Company. Our attitude towards the Company ought certainly to be clearly known by this time; and we can declare it in a few words: With their past financial arrangements we have little concern, excepting in so far as they have operated detrimentally on the price of their mantles, and have dragged upon the heels of progress; with the Directors' policy and business methods before (say) about the time of the advent of the Kern burner, we were not particularly struck; but the more enlightened methods and commercial principles upon which the business is now being conducted have our full sympathy. But even this sympathy will not hush our cry for the cheapest and best that can be obtained in incandescent mantles to benefit the gas industry of this country. We care not whether the cheap, serviceable mantle comes from the west or from the east so long as incandescent lighting obtains the same hold of the public in this country that it has obtained in Germany through the medium of the low-priced mantle. The Welsbach Company themselves tell us that, since their recent substantial reduction in the price of mantles and burners, the demand has increased by 50 per cent. This is satisfactory; and it points the direction in which they must, and sooner or later will have to, further tread. The question of the relation of profits to the heavy capital with which the present administration is encumbered is a serious one for them; but in it the public, the gas industry, or the "JOURNAL" have no concern whatever. The public want incandescent lighting; and the gas industry desires to push it. But when the public hear that in Germany mantles can be obtained for about half the price charged here, when they are offered at their own doors mantles for fourpence which give a satisfactory light, they ask why they cannot obtain the Welsbach goods at the same figure? It passes their understanding. The day is gone when we can talk of mantles being inferior at the price of 4d. or 4½d.; and from a remark made at last Wednesday's meeting of the Welsbach Company, the shareholders are not altogether ignorant on the point. They no doubt find, as we have done, that it is no use speaking of inferiority when our friends reply by pointing to brilliantly glowing mantles which have been purchased for about 4d. apiece, and yet have given a profit to the vendor. And our experience is that of gas managers; and they, like ourselves, cannot shut their eyes nor their ears. We could say more on the point, but it is no use labouring it. What we have written has not by any means been prompted by a spirit of hostility to the Welsbach Company. Nothing would be more pleasing to us than to see the successors of the Company who introduced incandescent lighting into this country the channel through which the gas industry obtained the means in the way of yet cheaper mantles of putting into the homes of rich and poor alike, and into every apartment of a house, the advantages to be derived from this method of illumination. In all the efforts of the Company to make progress towards this end, our pen and our columns shall be at their service, but others too will not knock at our door in vain.

To-day the Welsbach Company are the masters of the incandescent gas lighting field of this country; and, so far as we know, they may continue to be so for some years longer. But their right to the position will continue to be assailed. Upon the rumours in the City of which we have already spoken, we made inquiries; and we heard that a new Company was being promoted to exploit a mantle which, we believe, is to be known as the "Standard." But about this Company or about the mantle, we have nothing to say at present. We have also learnt that the "Voelker" Mantle Company intend almost immediately to commence business. This mantle is not a stranger to readers of the "JOURNAL"—an article describing it and reports by Professor Lewes having appeared in the numbers for Feb. 14 and 28, 1899. It may be remembered that one of the claims for this mantle is that its illuminating power starts at about 70 candles, and then in use it gradually increases in brilliancy—in fact

tests have been made which gave the mantle credit for an increased candle power of fully 12½ per cent. after about 2000 hours' use. The proposal of the Company is to put the burner and mantle, with side support for the latter, on the market for 2s. One advantage of the side support is that it can be raised or lowered by a small screw to suit the length of the mantle—for instance, if the mantle becomes frayed in use, the support can be readily lowered. The Directors of the Company have no intention—at all events at present—of touching glassware or fittings; they being of opinion that the cheapness of their burner and mantle "brings them within the reach of the million," and that their best policy is to push them, and them alone.

Then we found that the "United Chemical Works"—a concern of which we had never heard before, with offices in the City—appeared to be doing a very good business in mantles known as the "Guaranty." In fact, we are told (and we give the statement for what it is worth) that in England alone, something like 60,000 of these mantles a week are being distributed. On calling at the offices of the Company, our attention was directed to a large poster, on which it was announced that: "Recognizing the excellent quality of our mantles (known as the 'Guaranty' incandescent mantles), and the keen opposition they have encountered from us, the Welsbach Incandescent Gas-Light Company, Limited, by their Counsel (Mr. Thomas Terrell, Q.C.), applied on Tuesday, the 4th day of September, 1900, to Mr. Justice Farwell to stop the sale thereof, by us or our customers, by means of an interim injunction. After hearing our Counsel (Mr. Wm. Neill), the Judge declined to stop us, in spite of the Welsbach Company's offer to bring £25,000 into Court. If anything were wanting to convince the public of the superior quality of our goods, it is the jealousy of our competitors. But why should you pay the Welsbach Company 7s. 6d. per dozen, when you can buy from us for 4s. 6d. per dozen?" This style of advertising does not appeal to us; but it may net the public. What rather appeals to us is the fact that these mantles can be bought at 4s. 6d. per dozen, and that samples were freely offered to us from stock for trial purposes. In the few days during which one has been in use, it has given as much satisfaction as a more expensive article; and we have independent testimony, obtained direct from one who has had much experience with incandescent mantles, that on certain high-power lamps he has found them more durable and equal in illuminating value to other mantles. And our informant accompanied this expression of opinion with the remark "There is one"—pointing to a lamp from which came an exceedingly brilliant light. We have no interest in bolstering up this mantle any more than any other; but what are we to say to such testimony? We cannot deny the testimony of our own eyes, nor the testimony of a disinterested and practised user. And these are mantles, made in Germany, and sold here at 4½d. each!—manufacture, transit, and profit all included. But how long they will be sold here is another question. Already the Welsbach Company, as we have shown, have tried to stop the trade in them; and writs have been served on some of the users. But the "United Chemical Works" emulate quondam competitors of the Welsbach Company by asking users to report to their Solicitor "any attempt on the part of the Welsbach Company to terrorize." If we have correctly understood, the introducers of the "Guaranty" mantle do not deny that it is made on the same principle as the Welsbach; but they dispute the validity of the 1893 patent. Their point appears to be that the specification of the 1886 Welsbach patent describes and claims making mantles of pure thorium oxide or thorium oxide alone; and that in one of the Sunlight cases it was established (1) that pure thorium oxide gives practically no light, and (2) that what was known as "pure thorium" in 1886 was really thorium containing a small quantity of cerium. Therefore, they contend that the validity of the 1893 patent can be impeached on the ground that the alleged invention was merely the discovery of what were the real components of the mantles sold from 1886 to 1893, and of the best proportions in which to use them, and therefore was not proper subject-matter for a patent. Others who are making mantles hold the same view; and this looks like the point over which the next contest will rage. Further litigation there must be if the Welsbach Company are to retain their monopoly (if so it can at present be called); and we are assured that, if they force the fight, they will not find their opponents unprepared to meet it. Upon this point we can say nothing further.

For the present we leave the subject with these remarks: Our three objects in writing have been to declare (if that were necessary) our independence, to urge the argument for even cheaper mantles than are supplied from the recognized source, and to give information which may or may not result in meeting the demand.

Our readers are aware that the Sulphate of Ammonia Committee offer three prizes to the growers of barley raised with sulphate, at the malting barley competition in connection with the Brewers' Exhibition at the Agricultural Hall. The winner of the first prize (£25) this year is Mr. R. Seabrook, of Tolleshunt D'Arcy, Essex; the second prize (£15) being secured by Mr. L. Briggs, of Belmesthorpe, Rutlandshire. The sample of barley shown by Mr. A. Day, of Stratford-on-Avon (a portion of 43 quarters grown on a loam soil with a subsoil of gravel), was highly commended by the judges.

VIOLLE ON CONTEMPORARY PHOTOMETRY.

THE most generally interesting of the reports presented to the International Electricity Congress at Paris was that by Professor J. Violle, on Photometry. A full abstract of the report has been published in the "Electrician;" and the following is a summary of its chief points of interest for gas photometrists. We depend upon our contemporary's translation of the text. Professor Violle started with a restatement of the resolutions adopted by the International Electrical Congress of 1896 with regard to photometric quantities and standards of light. These resolutions formulated a scheme of photometric data based on the conception of luminous intensity as referable to a point source, the value of which was styled the decimal candle, but for practical purposes was represented by the horizontal intensity of the Hefner lamp, corrected.

The present report deals with the later developments of photometry. First, it is stated that Professor Violle's own platinum standard of light, which has been so much criticized, has been reproduced by M. Petavel. The conditions of successful reproduction of the Violle standard are: (1) Chemically pure platinum; (2) a crucible made of pure lime—prepared by calcination of the carbonate—obtained by precipitating calcium nitrate by ammonium carbonate; (3) the hydrogen burnt must not contain hydrocarbons; (4) the gases must be in the proportion of four volumes of hydrogen to three of oxygen, mixed by passing the oxygen both through an inner tube and through an annular space outside the hydrogen tube. Under these conditions, the platinum is carried to a temperature little over the fusing point; and the luminosity of the metal is not altered by combined carbon. M. Petavel has constructed an apparatus by means of which a single operator can conduct the whole process. After the platinum is melted, gas turned off, and the perforated cover put over the crucible, the luminous intensity of the visible square centimetre of molten metal falls very rapidly at first, then rises with a flash, and varies very slowly for from 40 to 50 seconds. It is during this period that the readings are taken. Afterwards, the fall of intensity becomes rapid again. M. Petavel enters the readings for the period of slow variation on squared paper. The points so obtained are sensibly in a straight line; and this line is produced up to the abscissa corresponding to the flash. The value thus found is called the luminous intensity at the moment of solidification, which, it will be remembered, is the original Violle prescription. The experimental error is stated to be about 1 per cent. at the most.

Lummer and Kurlbaum have proposed to make a standard of light with platinum heated to less than the fusing point, and defined by the condition that nine-tenths of the energy radiated shall be absorbed by a layer of water 2 centimetres in thickness. This suggestion has been realized at the Reichsanstalt, at Charlottenburg; but it necessitates a complicated and uncertain train of apparatus, and the light is found to be too red for photometric use.

Another available source of constant and very high temperature is the electric arc. Electricians have known for some time that the area of the crater varies nearly as the current intensity, and that the luminosity follows nearly the same rule. Violle himself has shown that the brightness remains constant under variations of from 500 to 34,000 watts. Although the elements of a constant standard of light appear to be here, unfortunately the result of all attempts to produce such a standard by means of the carbon arc lamp have failed. A principal reason of this failure is the shifting of the most brilliant portion of the crater, which periodically revolves in the hissing arc, and is not steady with the silent arc. The application of electric incandescent lamps to this object affords an interesting study. Numerous experiments have shown that an incandescent electric lamp can be standardized and used if the pressure at the terminals is carefully regulated. But the regulation has to be extremely exact, since the luminous intensity changes much more rapidly than the voltage (5·5 times, according to Liebenthal).

This latter authority has made an extensive series of observations of the luminous effects of different patterns of incandescent electric lamps, and has found that the arrangement and looping of the filament makes a great difference in the distribution of the light. Where there are spirals or loops, the mean horizontal intensity may sink to 73 per cent. of the maximum ascertainable effect. Two determinations in mutually perpendicular directions do not as a rule give a satisfactory mean value. Three equidistant measurements are better; but even then the error may exceed 2 per cent. The Union of German Electricians have adopted the latter way of obtaining the mean horizontal intensity of an incandescent electric lamp. The photometer screen receives the rays emanating directly from the lamp, on the flat way of the standing part of the filament, and also the reflected rays from two mirrors suitably inclined. The mean error amounts to 1·9 per cent. The American method is to revolve the lamp at a speed of two revolutions per second. In order to arrive at the nearest actual intensity of such lamps, as used, it is sufficient to incline their axis, when under test, 45° from the vertical, as well as to revolve them.

On the subject of flame standards of light, Professor Violle enumerates as the modern representations of this kind of standard the French Carcel; the English Vernon Harcourt pentane (ten candles and one candle); and the Hefner amyl-acetate

lamp. The Carcel lamp continues to be used according to the prescriptions of Dumas and Regnault. The Hefner standard is certified by the Reichsanstalt. The whole of the height of the flame is used; and if this varies by one millimetre from the normal 60 millimetres, a difference of 3 per cent. of luminosity results. Liebenthal's researches on the Hefner standand show that, on the whole, its winter intensity is several per cent. higher than its summer brilliancy. This effect is chiefly due to water vapour. The effect of barometric pressure changes on this standard is not great. Liebenthal gives formulæ for correcting the Hefner standard for aqueous vapour and carbonic acid in the atmosphere. Deprivation of oxygen also affects it. The red colour of the Hefner standard and its feeble luminosity are its great drawbacks. Also, the mobility of the flame often necessitates an assistant operator. Otherwise the lamp gives very consistent values.

In 1891, Professor Violle himself determined the equivalent value of the Hefner lamp to be 1·026 "decimal" candles. Laporte has recently stated it at 0·885 "decimal" candle. This determination is based upon a Carcel lamp, taken at 9·6 "decimal" candles. With regard to the Vernon-Harcourt pentane standards, after repeating the claims of the author, dated 1898, Professor Violle remarks that Liebenthal has subjected the pentane standard to a study similar to that carried out on the Hefner standard. He found that great exactitude of regulation of the height of the flame is required; and also that the flame (apparently in the case of the one-candle standard) does not reach its maximum intensity till half-an-hour after lighting. The pentane lamp, although having a much stiffer flame than the Hefner, requires more attention. The influence of moisture is sensibly the same in both lamps. Barometric pressure, however, affects the pentane much more, according to the formula $\Delta y = 0{\cdot}00049\,(b - 760)$. This shows a variation of 2 per cent. for an alteration of 40 millimetres of the barometer scale. It is therefore necessary to allow for altitude, which is an objection. For all that, however, the superiority of the Hefner to the pentane standard is not regarded as clearly proved.

Professor Violle dismisses the Dibdin pentane lamp in a few words; saying that the proportion of air and pentane varies with the temperature and moisture in the room. On the other hand, he records that Methven's carburetted gas standard has given very good results. The Dutch Photometric Commission recommended the employment of a lamp of the Vernon-Harcourt type, modified to burn a mixture of 9 parts of benzene with 100 parts of ether. The intensity of this standard has to be 1·48 English standard candles; but Professor Violle does not criticize it. Acetylene standards come in for more detailed notice. Professor Violle himself uses a Carpenter burner, with a pressure of 30 centimetres of water. This flame is over 100-candle power for a consumption of 58 litres (2 cubic feet) per hour. The flame is of remarkable whiteness; its spectrum having the same range as that of fused platinum. Fery proposes to burn acetylene at the end of a thermometer tube about 0·5 millimetres in diameter. An American acetylene standard consists of a mixture of two parts of acetylene and one part of hydrogen burnt in pure oxygen. M. Blondel has constructed a chimney lamp burning a mixture of alcohol and crystallizable benzene; and M. Broca has proposed the use of an "albo-carbon" gas-burner as a standard. All this shows, according to Professor Violle, how difficult it is to obtain satisfactory results with flame standards. The greatest errors are due to variations in height of flames, which may amount to as much as 24 per cent. He thinks the old Carcel lamp the steadiest of all, since with careful handling the error may be kept below 0·8 per cent.

As to photometers, the instrument of Lummer and Brodhun is commended as an improvement on previous adaptations of the Bunsen principle, by reason of the sharpness of the dividing line between the two illuminated surfaces. Yet it is admitted that the instrument is not perfect, inasmuch as its action cannot be reversed—that is, the positions of the standard and test-light changed—without introducing risk of error. The photometers suggested by Blondel and Broca are also mentioned. But this division of the subject is not treated by the reporter in a very practical spirit; and it is not easy to tell whether he is discussing mere suggested appliances or apparatus actually obtainable for industrial or scientific purposes. This impression may be the fault of the abstract; but it is to be regretted that the learned reporter did not put upon record the types of photometers actually used by French, German, and English practitioners.

The next meeting of the Southern District Association of Gas Engineers and Managers will be held on Thursday, Nov. 15, at the Holborn Restaurant, under the presidency of Mr. D. Irving, of Bristol.

A description of the condition of gases, materials, and food in a mine which had been tightly closed for fifteen months was given by Mr. F. G. Meachem at the recent meeting of the Institution of Mining Engineers. When the mine was reopened, the air was analyzed, and was found to consist of 84 per cent. of nitrogen, 12 per cent. of fire-damp, and 4 per cent. of carbon dioxide. The gases were greatly compressed; and it is estimated that about 1½ million cubic feet escaped from the first borehole in 24 hours. When the mine was entered, it was found that the gases had not had any deleterious effect upon the food or the materials left in the mine.

THE INVESTOR'S OPPORTUNITY.

The great depreciation that has taken place in the market value of investment (as distinguished from speculative) securities in the past two or three years, has already been the subject of remark in the "Journal;" gas stocks having been not the smallest sufferers in this respect. We have before pointed out that the present is an excellent opportunity for purchasing the best class of stocks, as there is as certain to be a reaction in the not distant future as that spring will follow winter, or day follow night. The causes of the present state of affairs, and the reasons for holding that this state cannot, in the nature of things, be permanent, are ably discussed in an article by Mr. W. R. Lawson in the current number of the "National Review," entitled "The Investor's Opportunity."

The writer first points to the great downfall of what are commonly known as "gilt-edged" securities—*i.e.*, British Funds, Corporation and Colonial Stocks, Railway Debenture, Guaranteed, and Preference Stocks, and Indian Railways, which were at the zenith of an artificial appreciation in the summer of 1896, and are now at the depth of their depression. The depreciation that has taken place in those four years has been equal, on an average, to about 15 per cent. on the 1896 prices. Consols in 1896 touched 114; they have been bought this year at 97. Metropolitan Two-and-a-half per Cents. have fallen from 107 to 89; and Threes from 120 to 103. So with railway stocks, which, like gas stocks, stood at ridiculous figures four years ago. In that year, London and North-Western 3 per cent. debentures yielded 2·4 per cent. to the purchaser. At present prices they return over 3 per cent. Taking seventeen first-class securities, Mr. Lawson shows by a table that those stocks, which stood at an aggregate market price of £2222 10s. in July, 1896, were only quoted at £1908 10s. in the same month this year—an average fall of 14·1 per cent., while the yield to the purchaser rose from £2 15s. 5d. to £3 7s. The gas stock included in that table is the Commercial Company's Old Stock; the fall therein, according to the figures given by Mr. Lawson, being from £347 to £275 per cent. This, as the following comparison will show, is only a representative instance of the decline in the market value of gas stocks, and not by any means an exceptional case.

Stock.	Market Price. Oct., 1896.	Oct., 1900.		Yield upon Investment. Oct., 1896.	Oct., 1900.
Brentford 4 p.c. deb. . . .	132	118	..	£2 19 9	£3 6 8
Bristol 5 p.c. max.	130	117	..	3 15 9	4 4 9
Commercial old	343	267	..	3 18 0	4 12 8
Gaslight 10 p.c. ord. . . .	307	250*	..	4 2 3	4 7 2
„ 6 „ deb. . . .	210	190*	..	2 16 7	3 2 6
South Metropolitan ord. . .	145	130	..	3 10 3	4 0 10
„ „ deb. . .	172	159	..	2 17 9	3 1 10
Total	1439	1231	average	£3 11 8	£3 16 8

* Calculated from present price of converted stock.

The stocks quoted by Mr. Lawson, and those enumerated above, "are unimpeachable as to quality, and are as safe to-day at their low prices as they were at the high prices of 1896." Why then have they tumbled down so heavily? Because we have passed in the four years from a period of trade stagnation into one of unexampled activity. That is the prime cause of the fact, though in the case of gas stocks to say this is not to say everything; for those securities depreciate under such circumstances in twofold manner. All good securities stand lower when there is a pressing demand for money to provide the capital essential to trade expansion—the Consol market and speculative stocks vary inversely in strength—but gas stocks are especially hit by times of abnormally good trade, because, coals and other materials being in demand, and consequently dear, profits tend to rule lower in the gas world. This is a fact only too well known to our readers. It is, therefore, a source of satisfaction, and a sign of the confidence of the public in the future of the gas industry, that the depreciation in the representative gas stocks that we have tabulated is only barely equal to the average depreciation of the seventeen first-class securities that are quoted by Mr. Lawson.

The tendency for the price of high-class investment to vary inversely with the price of money is agrowing, not alessening, one; for the volume of "gilt-edged" securities bears, not only a small, but an ever-diminishing proportion to the volume of money seeking investment. Not more than 20 per cent. of the quoted securities of the country can now be put in the category of high class; and the consequence naturally is that, so soon as ever commercial enterprise ceases to require, or to attract, the investor's savings, there is a scramble for the safe stocks, and an enhancement of their market value quite unwarranted by any change in their character or yield. At no time was this adventitious enhancement more marked than during the first six months of 1896. The "Bankers' Magazine" publishes every month the market value of 325 representative stocks. At the end of 1895, that value was 3095 millions; by the end of June, 1896, it had risen to 3280 millions; and by August this year the figure had gone back below the level of December, 1895, standing at 3063 millions. But it would convey a false impression if one said that these stocks were worth 217 million pounds less now than four years ago. The difference is only a paper, not an actual, one. Indeed, as one would rather buy Consols at par

than at 114, they may be said to be worth more now to the purchaser than four years ago.

It is not without interest to glance at some of the groups making up the aforesaid 325 representative stocks. The shares of the four Gas Companies quoted have declined in market value since June, 1896, from £32,186,000 to £27,540,000—a drop of £4,646,000. On the other hand, the group of seven Coal, Iron, and Steel Companies show an appreciation of £5,346,000—a more than compensating rise; the two changes being by no means unconnected. The principal other groups to show increased values are American Railroads, Commercial and Industrial Companies, Shipping Companies, and Banks; all but the first being, in fact, the very concerns that would profit by a trade revival of a magnitude sufficient to account for the depreciation of other first-class stocks. The ten Water-Works whose shares are included show a fall from £22,012,000 to £19,248,000.

The obvious lesson to be drawn from the consideration of the causes of the great fall in gas and other first-class stocks is that the present is a splendid opportunity for the investor to buy them, as their recovery is absolutely assured. In fact, the man who bought coal shares in 1896 would do well if he sold them now and bought gas stock, as the pendulum has got to the end of its swing and is now falling back. Above all, the present is a time to invest, not to speculate.

THE WORK OF THE EXAMINATIONS DEPARTMENT OF THE CITY AND GUILDS OF LONDON INSTITUTE.

We have received from Sir Philip Magnus, the Superintendent of Technological Examinations of the City and Guilds of London Institute, the report on the work of the Examinations Department for the session 1899-1900. This is the 21st annual report; and, in presenting it, the Committee direct particular attention to the large increase this year in the number of registered classes in technology and manual training; the figures rising from 2087 in the year 1898-9 to 2460 in the past twelve months. The progress of the work of the department is indicated by the augmentation in the number of candidates presented for examination. The number of papers worked was 15,557, as compared with 14,978 in the previous year; and while only a few years ago all the examinations were held on two days, they extended this year to twenty, during the months of April, May, and June. Examinations were again held in India and several of the Colonies; and the results are given in special tables in the report. Money prizes to the value of £477 10s., distributed over 59 subjects, were awarded in the names of the contributing Livery Companies; and 103 silver and 156 bronze medals were given by the Institute. There was an increase from 1764 to 2182 in the number of registered classes; but there was no corresponding augmentation in the number of students in attendance—the figures being 34,189, against 34,176 in the year 1898-9. It is pointed out, however, that the increase in the period covered by the report was really greater than these figures indicate, as it was found that many of the schools forwarded, at the beginning of the session, only the approximate, and not the actual, entries. The number of candidates examined this year was 14,551, and the number of passes was 8114, as compared with 14,004 and 7962 in 1898-9. Of the entire number of candidates, 2729 were examined in London, against 2662 last year; and they secured 69 of the 259 prizes awarded—59 being gained by students in attendance at the Institute's schools. The grants to London classes on results will be discontinued after this year.

With these introductory remarks on the general work of the department, we turn to the section of it which has a direct bearing upon the gas industry—viz., the examinations in "Gas Manufacture." These are conducted by Dr. Harold G. Colman. The papers set at the last examinations were published in the "Journal" for the 8th of May (p. 1238); and an indication of the nature of those to be prepared for next year has already been given (*ante*, p. 532). In the session just closed, there were eight registered classes, against eleven in 1898-9; the number of students in attendance being 102, as compared with 160. There were 139 candidates at the examinations, and 64 of them passed; the previous figures being 168 and 81. Analyzing the results, in the Honours Grade, 8 candidates passed in the first class, 25 in the second class, and 23 failed; while in the Ordinary Grade, 7 passed in the first class, 24 in the second class, and 52 failed—the total passes being 64 and the failures 75, or 53·9 per cent. The names of the successful candidates were given in the "Journal" for the 26th of June (p. 1734); and those of the prize winners, in the number for the 31st of July (p. 272). Reporting upon the results, Dr. Colman says the general character of the answers was relatively much better in the Honours papers than in those in the Ordinary Grade; many of the latter being "very weak." The faults to which attention has been called on previous occasions—viz., lack of knowledge of construction and weakness in drawing—are still very noticeable, "even after making every allowance in the latter case for the limited time at the disposal of the candidates, and the inevitable hurry of the examination-room." He remarks that "in many cases far too much time was spent over the first few answers, owing to the candidates entering into the discussion of matters outside the question, with the result that they were only able to give very hurried answers to the remaining questions." Though instructions were given that not more than eight questions were to be answered, no notice was taken of them in a considerable number of cases. It has been suggested that the syllabus should be divided into two sections; and the Committee have the matter under consideration. Meanwhile, in order to prevent one of the causes of failure of candidates, referred to by the Examiner, the time has been extended to four hours. At the last examinations, there were two candidates from the Colonies—one from Sydney, and the other from Wanganui (N.Z.); and they both passed in the Ordinary Grade. With regard to the London candidates, 7 came from the Battersea Polytechnic, 1 each from the Borough and the South-West Polytechnics, and 25 from the Regent Street Polytechnic—three of the prizes being carried off by students at this institution.

WATER ACTS FOR 1900.

(*Continued from p.* 1011.)

The Airdrie, Coatbridge, and District Water Trust Act, 1900, constitutes and incorporates a Water Trust for the burghs of Coatbridge and Airdrie, and the districts adjacent thereto, in Lanarkshire; acquiring the undertaking of a Company incorporated in 1846. The Trust consists of twelve members; and after five years, the number may be altered by the Secretary for Scotland. No member of a constituent Local Authority can be an officer of the Trust. The Trustees are to give the Company, within six months of the passing of the Act, notice of their intention to purchase; and the purchase must be completed within six months of the issue of the arbitrators' award. In addition to the ascertained value of the property, the Company are to receive the reasonable costs of their Act of 1899, the reasonable winding-up costs, and "such reasonable compensation to the officials of the Company as, failing agreement, may be fixed by the arbiters or oversman." But in fixing such compensation, the offer of the Trustees to continue the officers in their employment is to be reckoned—provided that officials with twelve years' service may refuse to accept employment under the Trustees without losing his right to compensation. The Company must, within fourteen days before the commencement of the arbitration, deliver to the Trustees a statement of all debts and liabilities of the Company on capital account, and the amount thereof, including all continuing liabilities on existing contracts for works in process of construction; and the Trustees take over and pay all such debts and liabilities. The Directors are to prepare a scheme for the distribution of the purchase-money, to be submitted to the proprietors, any one of whom may insist on the project being referred to the arbitrament of Counsel. The District Committee of the Lower Ward of the County of Lanark have power to purchase their portion of the undertaking. The Trustees may supply water by measure for other than domestic purposes, after the domestic demands are met, at a price to be settled, in case of disagreement, by the Sheriff of Lanarkshire. An additional water loan of £50,000 is sanctioned. The accounts are to be audited by a professional accountant appointed by the Secretary for Scotland. The Trustees can take parliamentary action by consent of a majority of their body, with the approval of the Secretary for Scotland.

The Bury and District Water (Transfer) Act constitutes and incorporates a Joint Water Board consisting of representatives from the Councils of the respective boroughs of Bury, Haslingden, and Rawtenstall, and the Urban Districts of Radcliffe, Ramsbottom, Little Lever, Whitefield and Tottington, and the rural district of Bury, all in Lancashire; and transfers to this Board the water undertaking of the Bury Corporation, with the exception of the Chesham reservoir. The composition of the Board is described. The Chairman for the first five years is to be a representative of Bury; and the Vice-Chairman for the same period is to be a representative from elsewhere. Members of the Board must not be interested in the Board's contracts, nor derive any profit or emolument whatsoever from the funds. This provision does not extend to shareholders of companies. Differences arising out of the working of the Board are to be settled by arbitration under the Local Government Board. The financial relations of the Board and the Corporation are adjusted. Any surplus profits of the undertaking are to be applied to the reduction of the price of domestic supplies. Within six months, the Board are to settle a uniform price for water used for fire and other public purposes throughout the district. All the statutory financial powers of the Bury Corporation relating to water supply are transferred to the Board.

The Exmouth Urban District Water Act authorizes the District Council to purchase the undertaking of the Exmouth and District Water-Works Company, incorporated in 1864. In addition to the ascertained value of the property, the Council are to pay the Company £2000 towards their parliamentary and winding-up expenses. The officers and servants of the Company are to be compensated for loss of employment. Unclaimed shares of the purchase money not exceeding £500 may be paid into the County Court. Rates for domestic supply range from 7½ to 6 per cent. Shipping rates are 1s. for the first 100 gallons or less, and 6d. per 100 gallons after.

The Hemel Hempstead Corporation Water Act makes further provision for the purchase of the Hemel Hempstead Water-

Works by the Corporation. The inclusion of part of the borough in the area of the Great Berkhampstead Water Order, 1885, is altered. The purchase is to be completed, and the money paid by the end of the year. Officers and servants of the Company are to be taken over by the Corporation on the same terms as they enjoy under the Company, and are not to be arbitrarily or summarily dismissed by the Corporation. For the protection of the Hertfordshire County Council, records of pumping levels are to be kept. The maximum price of metered supplies is 1s. per 1000 gallons. An additional water loan of £15,000 is sanctioned. Surplus profits are to be divided rateably between the borough and the outside area. In the latter, they are to be applied to reducing the cost of water; but in the borough, they may be applied either to this purpose or to the district fund.

The Menstone Water-Works (Transfer) Act authorizes the Rural District Council of Wharfedale to purchase the undertaking of the Menstone Water-Works Company. The promotion of this Act was provided for by the Company's Act of 1899. The notice to treat must be given within three months. In addition to the value of the property, the Council pay the costs of the Company's Act of last year, with 4 per cent. interest from Jan. 1 last; the taxed expenses of winding up; and two years' salary to any officer (other than a Director) and servant (other than a weekly servant) of ten years' standing, who is not willing to continue, or is not continued, in the Council's service. The sum of £5000 is to be borrowed for water-works extensions, authorized by the Company's Act. Surplus profits are to be carried to the credit of the special expenses account of the contributing place of Menstone.

The Mountain Ash Water and Gas Act authorizes the Urban District Council to construct additional water-works, comprising an impounding reservoir in the parish of Llanwanno, Glamorganshire, called the Perth-gelyn reservoir. The waters of the River Clydach and its tributaries are to be taken, subject to the conditions imposed by the Act of 1886. The works are to be completed within seven years. Rates for domestic supplies vary from 8 to 7 per cent. The sum of £60,000 is to be raised for this purpose; and £5000 for the future extension and improvement of the undertaking, both repayable in 60 years.

The Otley Urban District Council (Water-Works) Act sanctions the construction of a reservoir in the parish of Middleton, for impounding the water of a stream called the March Gill, subject to the obligation to discharge compensation water at the rate of 140,000 gallons per day. The works are to be completed within seven years. The water supplied by the Council is to be effectually treated for the prevention of plumbism. The Council are not to supply water within the limits of the Ilkley Urban District Council, but are to supply the Council in bulk at the price of 6d. per 1000 gallons. The rates for domestic supplies are altered, and range from 7 to 5 per cent. The sum of £55,000 is required for the purposes of the Act, repayable in 60 years.

The Paignton Urban District Water Act authorizes the construction of additional water-works, including a reservoir for collecting the water of the Venford Brook, in the parish of Holne, and other works in Marldon parish. The waters taken are those of the Venford Brook and its effluents, all tributaries of the River Dart; and compensation water is to be discharged as provided. The works are to be completed partly in ten and fully in twenty years. The water-rate for domestic supplies is 12 per cent.; and the price of metered supplies, which can be demanded by any person for any purpose, is 1s. 6d. per 1000 gallons. There is a clause in the Act for the prevention of plumbism. The amount of the additional water-works loan is £70,000, repayable in 60 years.

The Spalding Water Act authorizes the Urban District Council to purchase the undertaking of the Water Company as from Oct. 11, 1900. The mortgage debt of the Company, and the interest thereon, are to be paid off by the Company prior to this date. Officers and servants of the Company are to be compensated for any loss of emolument. The South Lincolnshire Fen Water Acts, 1888 and 1890, are repealed. Rates for domestic supplies are 8 and 7 per cent. Supplies for all purposes may be by meter. A water-works improvement loan of £10,000 is sanctioned.

OBITUARY.

Mr. William Porteous, formerly Manager of the North Middlesex Gas Company, has just died at the advanced age of 96. For some time past, the deceased had been living in retirement; but he was well known and respected by all employed by the Company.

PERSONAL.

Mr. J. W. Turner, of Torrington, Devon, has been appointed Manager of the new gas-works at Scunthorpe. There were about ninety applicants.

Referring to the appointment of Mr. Sydney E. Stevenson as Engineer and Manager of the Devonport Gas-Works, the "Devon and Exeter Gazette" recalls the fact that when the Exeter Gas-Works were removed from Exe Island to their present site, they were remodelled and enlarged under the sole supervision of Mr. Stevenson, who succeeded the late Mr. T. Dand as Manager; an important feature being a large gasholder and tank designed by him, and inaugurated by the Mayor and Corporation in 1878. During his residence in Exeter, Mr. Stevenson made many friends; and the "Gazette" thinks the members of the gas industry in the West are to be congratulated upon his return to this part of England.

Mr. P. M'Dougal, Assistant-Superintendent of the Gas Mains and Distribution Department of the Leeds Corporation, has been selected to fill the position rendered vacant by the death of Mr. S. H. Bradshaw, the Superintendent of Mains of the Sheffield Gas Company, announced in the "Journal" for the 11th ult., in which issue applications for the appointment were invited by advertisement.

A pleasant gathering of the employees at the Rotherham Gas-Works took place on the 20th inst., for the purpose of testifying their respect for their foreman, Mr. J. O. Whitaker (who has left the Company's service to take the management of the Portland Gas-Works, which have just been acquired by the District Council), by asking his acceptance of a solid gold pendant, suitably inscribed, and a case of drawing instruments. The presentation was made by Mr. F. Winstanley, the Engineer and Manager of the works, who wished the recipient every success in his new sphere. Mr. Whitaker expressed his thanks for the kindness shown towards him.

The recent completion of 25 years' service by Mr. J. A. Coombs as Sub-Manager of the Cheltenham Gas-Works was chosen by the workmen and staff as a fitting occasion for testifying in a tangible manner the good feeling and mutual regard which have characterized the dealings one with another during this long period. This they did by subscribing for a silver tea service, with oak tray, which was presented to Mr. Coombs by Mr. R. O. Paterson, the Engineer, at a pleasant gathering of the employees, numbering more than a hundred. In offering the gift, Mr. Paterson alluded to the cordial relationship which had always existed between himself and his lieutenant; and he heartily endorsed the good wishes of the men for Mr. Coombs's future welfare. Ringing cheers accompanied the presentation. Mr. Coombs heartily thanked the donors, and emphasized the advantage of cultivating good feeling between the workmen and officers by the latter manifesting constant regard for the welfare of every employee.

Composition of the Air of Paris.—M. Armand Gauthier has been studying the air of Paris, and has given in the "Comptes Rendus" the results of his investigations. He found the combustible portion of the atmosphere of the streets to have the following mean composition, calculated as parts per 100 litres: Free hydrogen, 19·5 c.c.; marsh gas, 12·1 c.c.; gases very rich in carbon (benzene and its analogues), 1·7 c.c.; carbon monoxide (with traces of hydrocarbons of the acetylene series), 0·2 c.c.

An Iron and Cement Reservoir.—Particulars have lately been given in the "Revue Technique" of a reservoir, constructed entirely of cement and expanded metal, for storing the filtered water from the works at Waalhem, near Malines, of the Antwerp Water Company. It was erected by M. Chassin, who built the large covered reservoir at Châtillon-sous-Bagneux, the capacity of which is 880,000 gallons. The Waalhem reservoir, which will hold 660,000 gallons, may be described as an immense box, the roof of which is supported by cement pillars with an iron core capable of resisting a pressure of 6,600,000 lbs. The floor, sides, and roof have a coating an inch thick. The quantities of materials used were: Concrete and cement mortar, 2200 cubic feet; cement, 250 metric tons; expanded metal, 6000 square yards; and the heavy iron for the framework of the reservoir, 30 metric tons.

Natural Gas in America.—According to the annual report which was recently issued by the United States Geological Survey Department, the total value of the natural gas produced and marketed in the United States during last year was $20,026,864, while the corresponding amount for 1898 was $15,296,813; showing a gain of $4,730,051. This gain is due in part to the slight increase in the prices charged to customers, and to the securing of more complete returns, but mainly to the increased bulk of natural gas produced and marketed. This has been accomplished against a declining pressure in all the old fields, as there was little new territory developed during the year, except in the extreme south-western portion of Pennsylvania and a part of West Virginia, in which some virgin territory, which has not felt the drain of adjacent wells, was developed. The increased delivery was due principally to the enlargement and multiplication of the pipe-lines of the old companies, the application of the gas compressor on a large scale, and more careful manipulation of the wells and lines so as to anticipate the requirements of customers. West Virginia made the largest increase of all the gas-producing States. The total number of wells producing gas operated at the close of 1898 was 8453; whereas at the close of 1899 it was 9333. This was an increase of 880 wells, or more than 10 per cent. of the number at the close of the preceding year. The increase in the value of gas sold during 1899 was 31 per cent. Of the total value of natural gas produced in 1899, the Appalachian fields supplied 60 per cent., and the Lima fields 37 per cent.; leaving only 3 per cent. for the production of all the other fields in the United States. Natural gas was used last year in 13 iron-mills, 63 steel-works, 196 glass-works, and 3947 manufacturing establishments of other kinds than those specifically mentioned.

THE INTERNATIONAL GAS CONGRESS.

THERMIC REACTIONS IN THE DISTILLATION OF COAL.

By M. Euchene.

[A Communication to the International Gas Congress in Paris.]

The valuable communication on the "Thermic Reactions which occur during the Distillation of Coal," which was presented by M. Euchêne, on behalf of the Paris Gas Company, to the International Gas Congress, forms, with appendices, a volume of upwards of 200 pages. No useful purpose would be served by the reproduction in our columns of the full text of this memoir; and we shall therefore in the sequel give only its more salient points, and the conclusions drawn from the investigation. The original memoir, however, presents an excellent example of the experimental aptitude and lucidity of reasoning and exposition which is characteristic of the bulk of the research work by M. Euchêne's countrymen. It may be commended to any who may be about to undertake similar exhaustive investigations, not so much for the intrinsic value of the results recorded—though this is considerable—as for the indirect benefit which a study of the train of reasoning and methods of research adopted will certainly impart. It will, unfortunately, not be possible to do more than present a bare account of the researches in the following abstract of M. Euchêne's communication.

The first of the two parts of the memoir treats of the thermic reactions; the second of matters which incidentally had to be investigated in connection with the ground covered by the first part. The latter opens with a general survey of the thermic reactions which occur in the distillation of coal. It is remarked that hitherto the thermic reactions of gas manufacture, and especially the determination of the heat needed for the distillation of coal, have not been treated in an exhaustive and conclusive manner, owing chiefly to the complexity of the questions involved in their study. Coal is a body of variable composition; and the chemical analysis of gas and tar, which are the chief products of its distillation, has not yet been brought to perfection. The heat supplied and consumed has to be determined; but the determination rests on more or less reliable thermometric readings. Previous attempts to investigate the subject have failed for want of practical data. The interpretation of the results of the inquiry will differ according to the position taken. The practical gas maker desires primarily to know what is the minimum consumption of fuel per ton of coal distilled. Consequently he regards the amount of heat needed for the distillation of the coal as that afforded by the fuel consumed in the furnace. That amount of heat, however, will clearly vary with the type of furnace and apparatus employed, and will be quite distinct from the heat of decomposition of the coal, as scientifically defined. The heat of decomposition is invariable for a particular variety of coal. The coal is transformed from a solid into gas, coke, tar, ammoniacal liquor, &c.; and the transformation is attended with the absorption or liberation of a certain quantity of heat, which it is desirable to determine. The complication of apparatus used for the distillation, and the numerous losses of heat, render the determination very laborious and uncertain, if the industrial transformation of the coal is taken as the starting-point for the study. Nevertheless, the present investigation follows this plan: A heat balance is drawn up, showing on the one side the heat generated and on the other side the heat expended; the difference found between the quantities on the two sides ought then to represent the heat of decomposition of the coal.

From these introductory comments, M. Euchêne proceeds to the "Investigation of the Heat of Distillation of Coal." For every 100 parts by weight of coal carbonized, a certain quantity of fuel, which develops a certain number of heat units, has to be consumed. Let the heat developed by the fuel be represented by A calories per 100 parts by weight of coal carbonized. Some of these A calories are to be traced: (1) As heat carried away by the volatile matters—*e.g.*, gas, water, tar, &c. Let this portion be represented by D. (2) As heat carried away by the smoke in the flue = C. (3) As heat retained by the coke = E. (4) As heat lost by radiation = F. (5) As heat carried away by the ashes and clinker = H. Then the difference A−[C + D + E + F + H] will represent the heat needed for the decomposition of the coal. Let this quantity of heat be termed x. Thence we get the equation (1):—

$$x = A - [C + D + E + F + H],$$

which represents evident facts, though analysis of the operation of coal distillation shows that it involves reactions which afford a very interesting study. These internal reactions must be considered in the light of thermo-chemical data.

Coal, consisting of a mass of ternary compounds, containing carbon, hydrogen, and oxygen principally, with a little nitrogen and sulphur, is ordinarily associated with some water and earthy matter. All the constituents (except the moisture) are in the solid state; and they undergo transformation into solid and volatile products when the coal is distilled. The solid products consist of carbon, sulphur, and ash, with traces of nitrogen, hydrogen, and oxygen. The volatile products comprise carbonic acid, carbonic oxide, marsh gas, hydrogen, benzene, and ethylene and its homologues, which bodies form the chief constituents of the gas; sulphuretted hydrogen, carbon bisulphide, hydrocyanic acid, thiocyanic acid, and hydrochloric acid, all of which occur only in small quantity and are extracted; water, with some ammonia; and tar consisting of various compounds of carbon, among which naphthalene is conspicuous. In the coal they were in the solid state; and distillation has, in the first place, decomposed the ternary compound and volatilized a number of bodies. A part of the carbon has been converted into carbonic acid and carbonic oxide, by combination with oxygen; and into marsh gas, benzene, ethylene, and tar by combination with hydrogen. A part of the hydrogen has combined with oxygen to form water; and minor changes have produced ammonia, sulphuretted hydrogen, &c. The formation of these bodies has, however, been attended by liberation or absorption of heat; and hence it affects the heat produced or the heat expended. The following table gives the heats of formation of the chief constituents of gas:—

I.—*Substances Formed with Liberation of Heat.*

	Calories per Kilogramme.
Carbonic acid, CO_2	liberates 8,080 of amorphous carbon.
Carbonic oxide, CO	„ 2,473 „ „ „
Marsh gas, CH_4	„ 1,791 „ „ „
	or 1,343 „ marsh gas.
Water (liquid), H_2O	„ 34,462 „ hydrogen.
Sulphuretted hydrogen, H_2S	„ 135 „ sulphuretted hydrogen.
Ammonia, NH_3	„ 717 „ ammonia.

II.—*Substances Formed with Absorption of Heat.*

	Calories per Kilogramme.
Benzene, C_6H_6	absorbs 125 of amorphous carbon.
	or 115 „ benzene vapour.
Ethylene, C_2H_4	„ 517 „ amorphous carbon.
	or 443 „ ethylene.
Carbon bisulphide, CS_2	„ 411 „ carbon bisulphide.
Cyanogen, CN	„ 1,319 „ cyanogen.
Tar (mean composition)	„ 300 „ tar.

Tar may be regarded, without great error, as having a mean heat of formation equal to that of naphthalene—*i.e.*, 300 calories.

As all coals do not behave similarly, it is necessary to determine what coal is to be used in making the gas before a heat balance can be drawn up. Wood, peat, lignite, and gas coal, when distilled under similar conditions, yield gas and secondary products similar in character, but showing, on close examination, remarkable differences. Regnault first made a methodical classification of fuels; and his results and scheme have been confirmed by recent researches by Mahler. M. Euchêne gives a table, based on the work of Regnault and Mahler, showing the elementary composition of typical fuels, and then prepares the following table showing St. Claire Deville's classification of gas coals. The figures refer to the substance of the coal after ash and moisture have been deducted.

Coal. Type.	Volatile Matter. Per Cent.	Elementary Composition. Carbon.	Hydrogen.	Oxygen.	Nitrogen.
No. 1	29·48	88·38	5·06	5·56	1
„ 2	33·88	86·97	5·37	6·66	1
„ 3	36·42	85·89	5·40	7·71	1
„ 4	40·66	83·37	5·53	10·10	1
„ 5	43·99	81·66	5·64	11·70	1

The percentage of nitrogen does not change progressively, but varies with conditions which are not material for the present purpose. It has therefore been taken as constant. The volatile matter increases from Type No. 1 to No. 5; and we should expect the quantities of heat liberated and absorbed through the formation of volatile matter to increase with the proportion of the latter. Calculation will confirm this anticipation. These coals, as employed in gas making, would contain ash and moisture; and M. Euchêne next gives tables showing the products of distillation, with the quantities of heat liberated and absorbed, for these five types of coal and for peat. We reproduce the more significant portions of one of these tables—viz., that referring to coal of Type No. 3, which is the one on which the most exhaustive experiments were subsequently made.

Coal of Type No. 3.

Products of Distillation, with Heat Absorbed and Liberated.

100 parts (by weight) of the coal.

Consist of—			Forming on Distillation—				Parts.
3·31 parts moisture			Ammoniacal liquor				3·310
7·21 „ ash			Ash				7·210
76·00 „ carbon	Solid		Coke				61·611
			Retort carbon				0·100
	Liquid		Tar				4·687
	Gaseous	Carbonic acid	0·284				
		Carbonic oxide	1·352				
		Marsh gas	5·601	9·564			
		Benzene	1·016				9·602
		Ethylene	1·311				
		Cyanogen	0·036	0·038			
		Carb. bisulphide	0·002				
4·78 „ hydrogen	Solid		Coke				0·469
	Liquid		Ammoniacal liquor				0·388
			Tar				0·327
	Gaseous	Hydrogen	1·366				
		Marsh gas	1·867	3·537			
		Benzene	0·086				3·596
		Ethylene	0·218				
		Sul. hydrogen	0·019	0·059			
		Ammonia	0·040				

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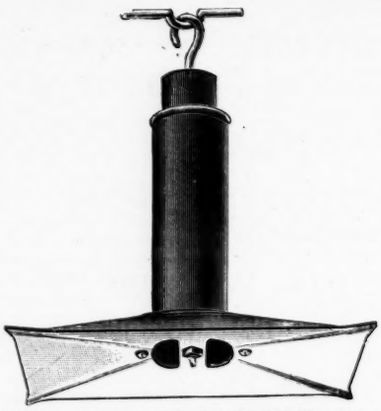

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			Am. liquor . . 0·183	0·610
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1·00	„ sulphur	Solid	Coke	0·683
		Gaseous	Sul. hydrogen . 0·306	
			Carb. bisulphide 0·011	0·317
100·00 parts.				100·000

Or grouping the products in the usual manner, the 100 parts (by weight) of the coal yielded—

	Parts by Weight.	
Coke—		
Ash	7·210	
Carbon	61·611	
Hydrogen	0·469	
Sulphur	0·683	
Nitrogen	0·270	
		70·243
Gas—		
Carbonic acid	1·042	
Carbonic oxide	3·154	
Hydrogen	1·366	
Marsh gas	7·468	
Nitrogen	0·385	
Benzene	1·102	
Ethylene	1·529	
		16·046
Ammoniacal liquor—		
Moisture in coal	3·310	
Formed	3·495	
		6·805
Tar—		
Carbon	4·687	
Hydrogen	0·327	
Oxygen	0·436	
		5·450
Sulphuretted hydrogen		0·325
Ammonia		0·223
Retort carbon		0·100
Cyanogen		0·078
Carbon bisulphide		0·013
Other products, or unaccounted for		0·717
Total		100·000

The yield of gas was equal to 30·64 cubic metres per 100 kilos. of the coal (= 10,995 cubic feet per ton). The composition of the gas in volumes per cent. was as follows :—

Hydrogen	50·10
Marsh gas	34·03
Carbonic oxide	8·21
Ethylene	3·98
Carbonic acid	1·72
Nitrogen	1·00
Benzene	0·96
	100·00

The heat liberated in the formation of compounds would be as follows per 100 kilos. of coal distilled :—

Compound.	Amount. Kilos.		Kilos.		Heat of Formation.		Heat Liberated. Calories.
Carbonic acid	1·042 containing carbon		0·284	×	8,080	=	2,295
Carbonic oxide.	3·154	„ „	1·352	×	2,473	=	3,343
Marsh gas	7·468			×	1,343	=	10,030
Sulphuretted hydrogen	0·325			×	135	=	44
Ammonia	0·223			×	717	=	160
Water	3·495 containing hydrogen		0·388	×	34,462	=	13,371
				Total			29,243

And similarly the heat absorbed would be—

Benzene	1·102	×	115	= 127
Ethylene	1·529	×	433	= 677
Cyanogen	0·078	×	1,319	= 103
Carbon bisulphide	0·013	×	411	= 5
Tar	5·450	×	300	= 1,635
	Total			2,547

Equally full data are given by M. Euchêne for the remaining four types of coal and for peat; and then follow two tables summarizing the whole. The more important figures from these summaries are tabulated below.

These tables suggest the following remarks: (1) That there is very close agreement between the results of the elementary analyses and the practical results. A slight excess of oxygen is found; but this is doubtless due to the fact that the oxygen is estimated by difference. (2) That the heat liberated during distillation ranges from 76,564 calories for peat to 23,718 calories for coal containing little oxygen; and the heat absorbed varies

Type of Coal, &c.	Elementary Composition.							Volatile Matter Obtained on Distillation. Percentage by Weight.				Heat Liberated during Distillation.		Heat Absorbed during Distillation.		Per-centage of Coke Obtained from the Coal.*	Carbon Volati-lized. Per Cent. of Total Carbon.	Fuel (Coke) Consumed Per Cent. of Coal Distilled.
	Moisture.	Ash.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Sulphur.	Gas.	Tar.	Water.	Total.	Calories per 100 Kilos.		Calories per 100 Kilos.				
												Of the Coal as Distilled.	Of the Coal *minus* Moisture and Ash.	Of the Coal as Distilled.	Of the Coal *minus* Moisture and Ash.			
No 1	2·17	9·040	77·790	4·460	4 890	0·880	0·770	14·283	4·500	4·584	23·367	23,718	26,712	1,976	2,225	75·661	15·50	..
„ 2	2·70	7·060	77·560	4·790	5·940	0·890	1·060	15·361	5·070	5·567	25·998	26,228	29,064	2,282	2,529	72·567	17·40	22·40
„ 3	3·31	7·210	76·000	4·780	6 820	0·880	1·000	16·046	5·450	6·805	28·301	29,243	32,681	2,547	2,846	70 243	18·80	21·00
„ 4	4·34	8·180	72·080	4·780	8·730	0·870	1·020	17·258	6·300	8·616	32·174	34,213	39,109	2,865	3,275	65·962	21·70	20·20
„ 5	6·17	10·730	67 010	4·630	9·600	0·820	1·040	16·797	6·400	9·861	33·058	32,017	38,528	2,832	3,408	64·016	22·80	..
Peat	17·50	5·342	47·475	5·207	22·975	0·825	0·676	36·250	8·300	26·500	71·050	76,564	99,230	4,333	5,615	27·304	55·00	..

* The nature of the coke was: No. 1, caked, dense, large; No. 2, caked, dense; No. 3, caked, medium size; No. 4, caked, friable, small; No. 5, caked, very friable, small; peat, not caked.

Remarks.—Distillation proceeded slowly in the cases of Nos. 1 and 2; rather quickly with No. 3; quickly with Nos. 4 and 5; and rapidly with peat.

from 4333 calories for peat to 1976 calories for coal containing little oxygen. The heat liberated, therefore, is greatly in excess of the heat absorbed. These facts, however, do not make it possible to draw any conclusion as to the amount of heat required for the distillation of the coal, because they give no idea of the value of the term which represents the heat of decomposition of the coal. This value will be found last, by difference. One piece of information, however, is afforded by the practical results—viz., that the consumption of fuel varies in inverse proportion to the amount of heat liberated by the volatile products. (3) That the fixed residue or coke increases progressively from peat to the coal containing least oxygen; and that the nature of the residue changes from a non-caking wood charcoal (from peat) to a well caked large coke (from the coal containing least oxygen). Also, that the rapidity of the distillation falls off from peat to the coal containing least oxygen.

A general and complete equation may now be set out for the heat exchanges. The first member will comprise two terms—viz., A = the heat furnished by the fuel, and B = the heat of formation of the volatile products which are formed with liberation of heat. The foregoing table gives the value of B. The second member will comprise seven terms—viz., C = the heat carried away by the smoke, D = the heat carried away by the volatile products of the distillation, E = the heat retained by the red-hot coke, F = the heat lost by radiation from the brickwork and mouthpieces, G = the heat of formation of the compounds of carbon which are formed with absorption of heat (the foregoing table gives the value of G), H = the heat carried away by the ash-pit refuse, and X = the heat of decomposition of the coal. The value of X has to be found by difference. The equation (2), therefore, is

$$A + B = C + D + E + F + G + H + X.$$

As already stated, the values of B and G are known from the table; and the values of the other terms have now to be ascertained in order to give us the value of X.

On comparing this equation (2) with equation (1) given earlier, it will be seen that $x = X - B + G$; or x (equation (1)) is the actual heat of decomposition, and X (equation (2)) is a value comprised in x. Regarding the coal as a ternary compound consisting of carbon, hydrogen, and oxygen, the decomposition may be supposed to occur in two stages—viz.: (1) The decomposition of this ternary substance into its elements, solid carbon, gaseous hydrogen, and gaseous oxygen. X will be the heat expended in this first stage. (2) The formation of volatile products. $-(B - G)$ will be the heat of formation; the negative sign indicating liberation of heat. Then the actual heat $x = X - (B - G) = X - B + G$. Consequently, X is only a portion of x.

M. Euchêne then proceeds to the determination of the values of the terms of the foregoing equation (2); starting with the first member of the equation, comprising A and B. The determination of A, or the heat furnished by the fuel, is first of all

considered. Coke, the fuel employed, was found to have the following mean composition in percentages by weight: Moisture 6, ash 10, carbon 81·5, hydrogen 0·5, sulphur 1·0, and nitrogen 1·0. A hectolitre of the coke weighed 40 kilos.—*i.e.*, a bushel weighed 32 lbs. The heat liberated when 1 kilo. of carbon is converted into carbonic acid = 8080 calories, when 1 kilo. of hydrogen is consumed to water, liquid at 0° C. = 34,462 calories, and when 1 kilo. of sulphur is burnt = 2000 calories. The latent heat of vaporization of the water formed will be included in the loss under the head of smoke, &c. The term A will be simple for ordinary direct-fired furnaces; but for generator furnaces, where the combustion is effected in two stages, there must be kept distinct: (1) The incomplete combustion of the coke in the producer, resulting in the formation of combustible gases, and (2) the combustion of these gases, having essential heat, with hot air from the recuperator. Whence it follows that the heat furnished in the furnace is made up of (*a*) the heat supplied by the combustible gases, (*b*) the heat of combustion of these gases, and (*c*) the heat supplied by the hot air. The term B, or the heat of formation of the volatile products, is given in the table; and for coal of Type No. 3, is = 29,243 calories.

The first term of the second member of equation C is the heat lost in the smoke or chimney gases. Now the heat held by a gas at a given temperature equals the product of the volume of gas and the heat needed to bring the unit volume of the gas to a given temperature. When the heat required to raise the temperature of a gas varies in proportion to the temperature reached, it is merely the product of the constant specific heat of the gas and the temperature. But when it does not so vary proportionately, the specific heat is no longer constant, but for any given temperature it may be found by an expression embodying the results of three observations at different temperatures. The specific heat rarely remains constant at high temperatures. In the sequel, only the heat (= Q) required to heat a gas to the temperature *t*, or the heat possessed by the gas at that temperature, need be considered; and this will have been determined directly. Only two determinations will have been needed—viz., (1) that of the temperature of the smoke or flue-gases, and (2) that of the heat needed to raise the smoke to that temperature. The temperatures were determined by the Le Chatelier pyrometer; and the results are shown below. A description of the calorimetric apparatus which was used to determine the heats corresponding to the temperatures is given in an Appendix to M. Euchêne's communication. But the heat needed to raise gases to given temperatures is not proportional to the temperature. It varies according to the nature of the gas, and also according to the temperature. Mallard and Le Chatelier, in 1881, ascertained these amounts of heat for certain gases at different temperatures; and Le Chatelier has communicated the formulæ for the principal gases. They are given in another Appendix. The results afforded by them, and the observations referred to above, are appended.

Heat which Raises to the Temperatures Stated One Cubic Metre [or, in parentheses, One Cubic Foot] of the named Gases:—

Temperature	1050° C.	975° C.	800° C.	650° C.	600° C.
Where observed	Temperature of the Chimney Gases at the Outlet of a Siemens Furnace.	Smoke or Chimney Gases issuing from an Ordinary Furnace.	The (Combustible) Producer Gas.	Volatile Products issuing from the Retort.	Outlet of a Siemens Recuperator.
	Calories.	Calories.	Calories.	Calories.	Calories.
Nitrogen, oxygen, hydrogen, and carbonic oxide	343 (9·7)	317 (9·0)	257 (7·3)	207 (5·9)	190 (5·4)
Steam (total heat)	1005 (28·4)	956 (27·1)	851 (24·1)	767 (21·7)	741 (21·0)
Carbonic acid	606 (17·2)	550 (15·6)	426 (12·1)	329 (9·3)	298 (8·4)
Marsh gas	..	..	..	398 (11·3)	..
Sulphur dioxide	908 (25·7)	863 (24·4)	758 (21·5)	..	638 (18·1)
Benzene	..	..	..	1287 (36·4)	..
Cyanogen, carbon bisulphide, sulphuretted hydrogen, and ammonia				390 (11·0)	..

Tar [650° C.] 423 calories per kilo. [= 192 calories per pound].

The second term of the second member of the equation, D, is the heat lost through the volatile products of the distillation. These products are gas, tar, and water, &c., as given in the general table above for coal No. 3. Their temperature has to be determined. It was observed on top of the charge at a distance of 1 foot from the mouth of the retort, and was found to be 630° C. at the beginning and 735° C. at the close of the distillation. But as the bulk of the volatile products is given off in the first two hours, their mean temperature as they leave the retort may be taken to be 650° C. Mr. Foulis, of Glasgow, some time ago estimated their temperature at 600° C. In the ascension-pipe, at 8 inches from the mouthpiece, their temperature has dropped to between 420° and 440° C.; and at the hydraulic main the maximum is 80° C. Taking the composition of the volatile products, as already given, and the heat needed to raise them (as given in the last table) to 650°, calculation gives the following values for the heat removed by the volatile products in the distillation of 100 kilos. of coal, Type No. 3:—

	Calories.
Carbonic acid	173·7
Carbonic oxide	519·8
Hydrogen	3,151·2
Marsh gas	4,149·2
Nitrogen	63·4
Benzene	380·2
Ethylene	556·8
Sulphuretted hydrogen, ammonia, &c.	207·7
Gas, total	9,202·0
Water	6,492·0
Tar	2,305·4
Total	17,999·4

For the other four types of coal, the total heat removed by the volatile products from 100 kilos. of coal was similarly—

	No. 1.	No. 2.	No. 4.	No. 5.
Gas	8,839·5	9,224·2	9,131·9	8,447·6
Water	4,373·1	5,310·9	8,220·6	9,407·4
Tar	1,903·5	2,144·6	2,664·9	2,707·2
Totals	15,116·1	16,679·7	20,017·4	20,562·2

It will be observed from these figures that (1) the hydrogen and marsh gas are responsible for the bulk of the heat carried off by the gas; and (2) that the heat carried off by the gas is nearly constant for all the types of coal, but that removed by the tar and water—the latter especially—increases from Type No. 1 to Type No. 5. As the heat liberated and absorbed by the formation of the volatile products varies appreciably for the several types, it is clearly necessary, in drawing up an equation of the heats, to distinguish between these different types.

The next term, E, is the heat lost through the red-hot coke. When the couple of a Le Chatelier pyrometer is inserted in the charge in the middle of a retort, the temperature half-an-hour after charging will be found to be 500° C., and it will rise to 950° C. at the end of the period of distillation. Thus the coke must leave the retort at an average temperature of about 950° C.—in some retorts, and in some parts of each retort, rather less or rather more; but that will be a fair average. As the capacity for heat of carbon at high temperatures is given differently by different authorities, it was determined afresh for the purpose of this investigation; and the method used is described in the third Appendix to M. Euchêne's communication. It was found that the heat removed by 1 kilo. of coke at 950° C. was 350 calories (by 1 lb., 159 calories). Hence it followed that the heat removed by the amounts of coke obtained from each of the five types of coal was as follows:—

	Type No. 1	2	3	4	5
Calories	26,481	25,573	24,585	23,087	22,406

The next term, F, comprises the loss of heat through the brickwork, retort mouthpieces, grate, opening the retorts, &c. These losses vary with the season, time of day, and state of the atmosphere, and are not readily estimated. Existing data for the conductivity and radiating powers of brickwork at high temperatures were found to be unreliable; and the coefficient of conductivity was determined afresh by a method which is described in the fourth Appendix to the communication. The losses by radiation, &c., were thus found to amount, per setting per hour, to 54,824 calories with the ordinary setting of seven retorts, to 80,174 calories with a Siemens setting of eight retorts, and to 89,251 calories with a Siemens setting of nine retorts.

The last term, H, is the loss of heat through the ashes, &c.; and it may be taken from a metallurgists' observations at 400 calories per kilo. This figure is perhaps rather high for gas-works furnaces, as it refers to molten slag; but the error thus introduced would be of no moment.

The several terms of the equation having now been determined, they have been applied in the cases of coals, Types Nos. 2, 3, and 4, distilled in an ordinary setting of seven retorts; and in the case of coal No. 3, distilled in a Siemens setting of eight retorts. The ordinary setting is shown in longitudinal and cross section in figs. 1 and 2; the Siemens setting in figs. 3 and 4.

The following is a summary of the data and calculations in the case of coal No. 3 distilled in the ordinary setting. The calculations are shown in full in the fifth Appendix to the communication.

Coal Type No. 3

Heat Produced and Expended during Distillation in an Ordinary Setting.

Coke consumed = 21·20 { parts per 100 parts (by weight) of coal distilled.
Water evaporated from ash-pan = 6·05 do. do.

The composition of the coke was—

	Per Cent.
Moisture	6·0
Ash	10·0
Carbon	81·5
Hydrogen	0·5
Sulphur	1·0
Nitrogen	1·0
	100·0

The smoke or chimney gases consisted of 16 per cent. by volume of carbonic acid (containing 8·582 per cent. of carbon),

4·5 per cent. of oxygen, and 79·5 per cent. of nitrogen; and their temperature was 975° C.

M. Euchêne discusses the results of the observations made on the distillation of coals, Nos. 2, 3, and 4, in the ordinary setting. In the first place, he makes some comparisons of the three types of coals, with reference to the heat of decomposition and the thermic reactions which occur in the retort. He recapitulates the following data for the three coals (the figures are calories per 100 kilos.):—

Type.	Heat Liberated by the Volatile Products.	Heat of Formation of the Carbon Compounds.	Heat Carried Off by the Volatile Products.	Heat of the Red-Hot Coke.	X.	Heat of Decomposition.
No. 2	26,228	2282	16,680	25,573	22,707	− 1239
„ 3	29,243	2547	17,999	24,585	23,098	− 3598
„ 4	34,216	2865	20,017	23,087	25,000	− 6351

The negative sign before the values of x indicates that heat is liberated by the distillation of the coal. As the amount thus liberated is not large, it might be considered as falling within the limits of the probable errors in the observations. But it should be noted that the liberation of heat is supported by M. Mahler's results obtained in 1893 by a totally different method of research.

M. Mahler determined the calorific value of 100 kilos. of coal

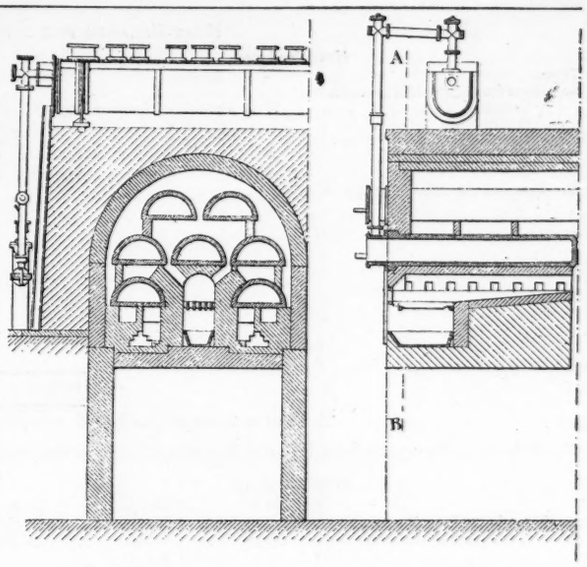


FIG. 1.

FIG. 2.

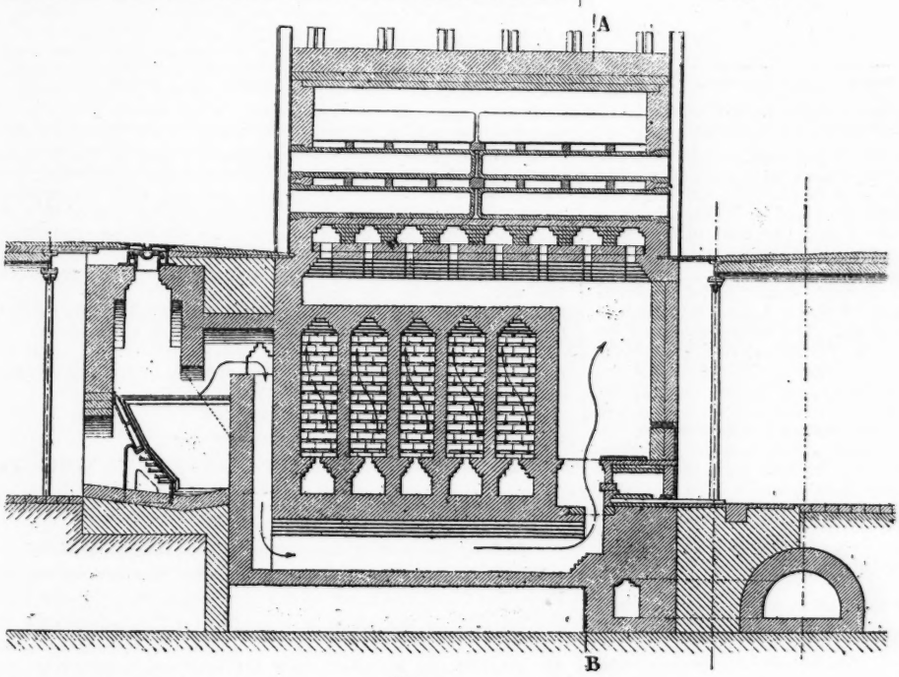


FIG. 3.

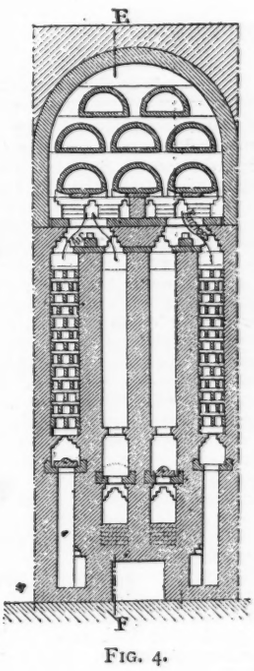


FIG. 4.

of Type No. 4, and the calorific value of all the products obtained on carbonizing it. The calorific value of the coal exceeded that of the products by 25,483 calories, which quantity of heat had therefore disappeared or been liberated during the carbonization. Consequently, the distillation or carbonization of the coal liberates heat. On comparing this figure with that found in the present researches for the same type of coal—viz., 6351 calories—it will be observed that the values both indicate liberation of heat. The difference of 19,000 calories, though apparently great, may be accounted for by the inevitable sources of error, especially as the errors would be in opposite senses in the two cases. For instance, in the present research, the heat of decomposition (x) has been computed by taking the difference between the heat produced (m) and the heat consumed (M), thus $x = M - m$. Here x has a negative value; and sources of error would make M low in the same manner as x. But in M. Mahler's method, $x = C - c$, where C is the heat of combustion of the coal, and c the heat of combustion of the products; and c is likely to be too low, and consequently x too great.

It is to be observed in the next place that the heat liberated by the volatile products increases from 26,228 calories for coal No. 2 to 34,216 calories for No. 4; while the heat of decomposition ranges from 1239 to 6351 calories. Further, the sum of the heat carried off by the volatile products and of the red-hot coke is nearly constant—viz., 42,253 calories for No. 2, 42,584 for No. 3, and 43,104 for No. 4. It follows that the heat of decomposition is characteristic of the different coals, just as is the proportion of volatile matter; but it is affected by the physical phenomena of the distillation. Fusion takes place to an extent which varies with the type of coal. It is more marked with No. 2 than with No. 4; and it is likely that fusion absorbs a certain amount of heat.

In the third place, it is noticeable that the carbonization of coal liberates heat if it is assumed that there can be recovered (1) the heat carried off by the volatile products, (2) the heat of the hot coke, (3) the heat of the ashes, (4) the heat of the chimney gases, and that radiation can be completely prevented. Therefore, if heat is once applied to start the carbonization, it will proceed without expenditure of fuel. In other words, carbonization of coal can take place without expenditure of fuel. This observation elucidates the phenomenon of the heating up of coal, which is now admitted to be due to oxidation. It is not the sulphur of the coal which determines the liability to oxidize; as the coals which contain much sulphur, such as English coals, are less liable to spontaneous ignition than those which contain very little sulphur, such as Belgian coals. When the oxidation occurs in a small heap, the heat produced is dissipated, and heating does not occur. But when the heap of coal exceeds a certain height—13 to 18 feet—and especially when the lumps are large and the intervening air spaces considerable, the absorption of the enclosed air by the coal produces a little heat, which favours oxidation of the coal. Then, thanks to the feeble conductivity of the coal, distillation commences, and continues slowly until the volatile matter is completely separated. After a time, the conversion of the coal into coke may be almost as complete as in a retort.

Though complete recovery of heat, such as has been imagined in the case of the heap of coal, cannot be effected industrially, it is desirable to consider under what conditions an approach can be made to it. In the first place, the average composition of

HEAT-BALANCE FOR 100 KILOS. OF COAL.—No. 3.

Heat Produced. Term.	Kilos.	Calories.
A.—Heat from 21·2 kilos. of coke—		
Carbon	17·278 × 8,080 =	139,606·240
Hydrogen	0·106 × 34,462 =	3,652·972
Sulphur	0·212 × 2,000 =	424·000
		143,683
B.—Heat of the volatile products		29,243
		172,926

Heat Consumed. Term.	Cubic Metres.	Calories.
C.—Loss of heat through the smoke at 975° C.—		
Carbonic acid	32,213 × 549·700 =	17,707
Oxygen	9,058 × 317·153 =	2,875
Nitrogen	160,033 × 317·153 =	50,753
Water of the coke	1,582 × 956·224 =	1,513
„ „ „ ash pan	7,525 × 956·224 =	7,196
„ from the hydrogen	1,186 × 956·224 =	1,139
Sulphur dioxide	148 × 863·000 =	128
		81,311
D.—Volatile products at 650° C.		17,999
E.—Red-hot coke at 950° C.	70·243 × 350 =	24,585
F.—Losses by radiation	$\frac{54,824 \times 24 \times 100}{5950}$ =	22,114
G.—Formation of carbon compounds		2,547
H.—Ash, &c. (15 per cent. of the coke)	3·18 × 400 =	1,272
X.—By difference	=	23,098
		172,926

The heat of decomposition $x = X - B + G = 23,098 - 29,243 + 2547 = -3598$ calories.

The following shows the heat-balance in percentages for the three types of coal, Nos. 2, 3, and 4, distilled in the ordinary setting:—

Heat Produced.	No. 2.	No. 3.	No. 4.
A.—Heat from the coke	85·27	83·60	79·80
B.—Heat of the volatile products	14·73	16·40	20·20
	100·00	100·00	100·00

Heat Consumed.	No. 2.	No. 3.	No. 4.
C.—Smoke, &c.	48·30	47·20	45·20
X	12·70	14·20	14·70
E.—Hot coke	14·40	13·20	13·60
F.—Loss by radiation	13·20	12·80	12·30
D.—Volatile products	9·40	10·40	11·80
G.—Formation of carbon compounds	1·30	1·50	1·70
H.—Ashes, &c.	0·70	0·70	0·70
	100·00	100·00	100·00

Heat of decomposition per 100 kilos. of coal distilled $x = X - B + G =$ No. 2. −1239 .. No. 3. −3598 .. No. 4. −6351 calories.

the chimney gases—carbonic acid 16 per cent., oxygen 4·5 per cent., and nitrogen 79·5 per cent.—shows an excess of 4·5 per cent. of oxygen. Such is the normal state of affairs with ordinary furnaces. What is the effect of this excess of air? The chimney gases theoretically should consist of 20·5 per cent. of carbonic acid and 79·5 per cent. of nitrogen. For the quantity of coke used, there should be produced 32,206 cubic metres of carbonic acid and 124,895 cubic metres of nitrogen—making a total volume of 157,101 cubic metres, in place of the 201,304 cubic metres produced with the usual excess of air. The heat carried off by the 157,101 cubic metres would be 57,315 calories, instead of 71,335 calories under the usual conditions. The excess of air therefore entails a loss of 14,000 calories, or 9·7 per cent. of the heat furnished by the coke. This important loss can be avoided only with difficulty, just as in other ordinary grates where the supply of air is not well under control. It is, however, possible to diminish the loss by altering the draught until incomplete combustion takes place in the bed of fuel, and a little carbonic oxide is formed, which is subsequently burnt by a little air admitted through holes in the furnace door. Only a little excess of air is needed by this plan, which is practically combustion in two stages, as is more thoroughly carried out in producer furnaces.

The water evaporated in the ash-pan is responsible for a loss of 7196 calories, or 5 per cent. of the heat furnished by the coke. This loss is unavoidable, as the furnace bars must be kept cool. In producers, the greater part of this water is decomposed and produces hydrogen. The use of the red-hot coke for fuel would result in an economy of 8933 calories, or 6·2 per cent. of the heat furnished by the coke. This economy is appreciable; but the practical difficulties of charging the furnace with the hot coke, and the interference with the stokers' routine, would often make it impossible to secure even a part of the advantage.

The loss of heat by radiation is influenced by the quantity of coal carbonized in the setting. For instance, seven retorts carbonized 5600 kilos. of No. 2 coal in 24 hours, with a loss by radiation of 23,496 calories per 100 kilos.; or 5950 kilos. of No. 3 coal, with a loss of 22,114 calories; or 6300 kilos. of No. 4 coal, with a loss of 20,885 calories. Now, if eight retorts were placed in a setting of the same size and surface, and 7200 kilos. of coal were distilled per 24 hours in them, the loss by radiation would be reduced to 18,260 calories per 100 kilos., or an economy of 5000 calories as compared with the distillation of No. 2 coal quoted above. This is equivalent to a saving of 3·2 per cent. of the heat furnished by the coke. For No. 3 coal, the losses by radiation amounted to 12·52 per cent. of the total heat, and were distributed among the top and sides of the setting, the mouthpieces, opening the retorts, &c. Economy at any one of these points would have little effect, as the loss at each is small. An appreciable effect on these losses can be made only by increasing the charge of coal per setting.

To sum up, the ordinary furnace and setting, as commonly used, appears susceptible of improvement being effected in the following directions:—

On the excess of air,	an economy of	9·50 per cent.
„ „ water in the ash-pan	„ „	4·90 „ „
„ „ red-hot coke	„ „	6·16 „ „
„ „ losses by radiation	„ „	3·20 „ „
	Total =	23·76 „ „

But gas engineers actually are inclined to give up the ordinary furnace, and adopt the plan of dividing the combustion into two stages—viz., (1) incomplete combustion, with formation of combustible gas, in a producer, and (2) combustion of this gas in the setting. Such distribution has the advantages of avoiding the destructive combustion on the grate of the ordinary furnace; of placing the grate at a distance from the setting, and separating the work done by the grate from that done in the setting or furnace proper; of securing an easily regulated supply of air to the setting; and of utilizing the heat of the chimney gases.

These advantages are considered in connection with the Siemens setting, in which only the No. 3 type of coal was carbonized for the purposes of this investigation.

(*To be continued.*)

GAS LIGHTING IN THE CHAMP-DE-MARS AND TROCADERO PARIS.

By M. AUGUSTE LÉVY.

[A Paper presented to the International Gas Congress at Paris.]

When the Paris Exhibition was in course of arrangement, the Paris Gas Company came to the conclusion that it would be to the interest of the whole gas industry if the portions of the Exhibition grounds and gardens in which gas appliances would (as in 1889) be installed were brilliantly illuminated by gas. Such a course the Company considered would prove the very best imaginable means of demonstrating the great improvements in gas technology—especially in connection with lighting appliances—made since the previous date. In addition, the innovation would contribute to the prestige of the Exhibition.

With this object in view, it was decided two years ago to devote the greater part of the money laid aside for the Company's exhibit at the Exhibition to this purpose; and in 1898 the offer of the Company was approved of by the Minister responsible for the arrangements of the Exhibition. The parks and gardens of the Champ-de-Mars and of the Trocadéro, it was settled, should be lighted by gas only, under the control of the Paris Gas Company. The Company agreed to make use of the most perfect appliances existent; and the plans of the installations proposed by them were submitted to the Executive of the Exhibition for approval, and were passed by the General Commissioner on Jan. 23 last.

Before alluding to the arrangement adopted in the present instance, it will be well to review the history of the incandescent system of lighting in public places, and the principles on which the Gas Company's own efforts were based. Up to 1877, the public lighting of Paris was effected by means of 140-litre burners arranged separately or in clusters. When, however, M. Jablochkoff was authorized in 1877 to light the Avenue de l'Opéra with his "candles," the Paris Gas Company laid themselves out to develop the "high-power" system. The so-called "Quatre-Septembre" burner of 1400 litres, which was introduced at this time for the lighting of the street of that name, had the advantage of consuming a considerable volume of gas within a single small area, owing to the concentration of a number of batswing burners. It gave the relatively great intensity (at that time) of 13 carcels, and consumed 105 litres of gas per carcel.

In 1889, experiments were made with regenerative gas-burners in the Avenue de l'Opéra and Rue de la Paix; and a few of these burners were used in the Exhibition of 1889. Some Guibout-Giroud burners were also tried. Each consisted of two to six jets, consuming up to 1200 litres of gas per hour. In the Rue de la Paix, the Schülke burner, consuming 350 litres per hour, and giving 7 carcels per burner, was likewise tried. The department of the Company entrusted with the superintendence of the experiments possessed at the time only one small photometric laboratory—in the basement of No. 6, Rue Condorcet. A complete installation was fitted up in 1890-91 alongside the Ateliers de Construction Mécanique, at Landy. In addition to an office and store, it includes three experimental rooms for the trial of heating apparatus, and a large photometer room, in which the most powerful lamps (of 550 carcels, or 5500 decimal candles) can be tested. It is nearly 30 feet in height, and well ventilated; so that the atmosphere of the lamps remains practically normal, despite the immense volumes of gas burnt. The photometer benches here are 23 feet in length.

About 1889, incandescent gas was still in the experimental stage. It was not until the end of 1891 that Welsbach mantles were made of uniform and sufficiently stout quality. At this time, the Company had only the No. 1 and No. 2 burners, using 80 and 120 litres of gas per hour respectively, and giving lights of 4 and 6 carcels. The question presented itself (in France and other countries) as to how it was possible to get incandescent burners of greater intensity than these. In 1893, we placed in the Landy laboratory a number of Welsbach burners using compressed gas. They consumed each 500 litres of gas per hour, were supplied with gas at a pressure of 1·3 to 2·5 metres of water, gave a lighting power of 25 to 40 carcels, and the mantles lasted from 80 to 100 hours. Not being made for this special purpose, the burners produced an unpleasant noise when in action; but the encouraging results, as regards intensity, obtained, led us to undertake the construction of suitable burners. The results obtained in the laboratory in May, 1894, enabled us to ascertain the best proportions of air and gas for maximum incandescence. In these trials, the gallery of an ordinary Welsbach burner, fitted with a mantle, was used. The burner was made from a copper tube without an injector, screwed into a copper globe fitted with two cocks. The gas, after passing through a meter, was led into the globe; while the air was supplied from a gasholder capable of giving a varying discharge. Lastly, the mantles were tried with and without a chimney. In these trials, efficiencies of 10 to 12 litres per carcel-hour were obtained. The maximum was with larger proportions of gas and air than in the Welsbach burners of that day.

The trials led to the construction of burners with an expansion chamber in the mixing-tube, whereby the minimum resistance was offered to the gas, and the maximum incandescence at the minimum of pressure was produced. Compression of the air in place of the gas was claimed at this time in a patent taken out by the Company, in which an efficiency of 42 carcels for a consumption of 450 litres of gas per hour was claimed for the burner.

In the meantime, the Denayrouze Company had worked in the direction of increasing the proportion of air by means of a forced draught, produced (among other ways) by a small electrically-actuated exhauster placed at the inlet of the burner. The burners were publicly tried in the Place du Palais Royale, in July, 1896. M. Denayrouze afterwards devised a new burner working with uncompressed gas, which has been available for use since February, 1897.

The French Welsbach Company placed the No. 3 burner on sale in June, 1897. It had an hourly consumption of 155 litres, and an intensity of 12·5 carcels.

With these burners in existence, therefore, in 1898, the Paris Gas Company decided that on the whole it would be more beneficial to gas interests to make use of the various burners then existent than to pursue the experiments which had already been started. The Welsbach and Denayrouze Companies, as well as the Paris Municipality, lent their support to experiments made in this direction. Incandescent gas on the high pressure system was used in Paris in 1898-99 (when six thoroughfares were lighted with Denayrouze burners of 270 litres per hour), though Welsbach burners had previously been installed as long ago as 1894.

As a preliminary to the task of lighting the Exhibition, the Company sought to secure, with the appliances which were to be lent to them by the Exhibition Authorities, the greatest efficiency possible with each lamp. They were anxious to obtain the greatest yield of light per mantle and per cubic metre of gas consumed. At the commencement, it was seen that two types of burners might be employed: (A) with gas at a pressure of 200 mm., with an hourly consumption of 350 litres, and an intensity of about 35 carcels; (B) with gas at normal pressure.

It was intended that the burners should be all on the Denayrouze system; but during 1899 the French Welsbach Company placed on sale burners of the Bandsept type without glasses—viz., (B) 9 carcels for 100 litres per hour; (C) 12·5 carcels for 150 litres per hour; and (D) 35 carcels for 300 litres per hour. The "D" burner was adopted for the lighting of the Champ-de-Mars, and the Denayrouze for the Trocadéro.

I may now refer to the photometric methods employed in the examination of these burners. The standard of light used throughout was the Bengel burner consuming 105 litres of gas per hour, and producing one carcel. As far as possible, the identical burner was used throughout. It was verified from time to time by the carcel oil-lamp. The Foucault photometer was the one used in cases where the lamp could be examined indoors. By making the benches of considerable length, lights of great intensity could be examined without change of standard; but, when necessary, the Bengel burner was replaced by other previously tested standards.

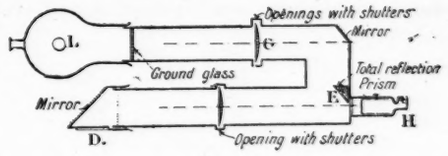


FIG. 1.

For outdoor work and for lamps in the interiors of buildings, &c., the Mascart photometer was used. (See fig. 1.) It is only 75 centimetres long, and is easily carried about in a case—being fixed for use on an ordinary photographic tripod. The two parts of the screen E are illuminated respectively by a portion of the light to be measured and of the standard light. The two fractions are adjusted to get uniform illumination of the screen. The standard L illuminates a piece of ground glass the image of which, produced by a lens A, is thrown, after two reflections at an angle of 45°, on to the disc E. The lenses producing these images are each fitted with a rectangular diaphragm, which can be made larger or smaller at will. The scale recording the sizes of these openings indicates the proportions in which the light of the standard and of the lamp being tested must be reduced in order to produce equal illumination of the disc E. The graduation of the apparatus is made in the laboratory by means of a carcel lamp. The receiving screen D can be inclined so as to measure the lighting effect at various angles; and glasses of various tints can be placed in it in order to aid in comparing illuminants differing in colour. In every case a large number of tests must be made, and the mean taken.

Since the height at which most lamps are placed prevents the eye from receiving the horizontal rays, an estimation of the total light (the "spherical intensity") becomes necessary. The arrangement of the laboratory photometer not permitting oblique rays to reach the screen, we used in the Landy tests the method of Ayrton and Perry, in which the rays are received on a plate of glass, and transmitted normally to the eye. The "coefficient of absorption" of this glass (by which is meant the ratio of total light received to light reflected) depends on the angle of incidence of the luminous beam. To avoid having to determine this coefficient at all angles, we arranged the apparatus so that the incident angle is always 45°.

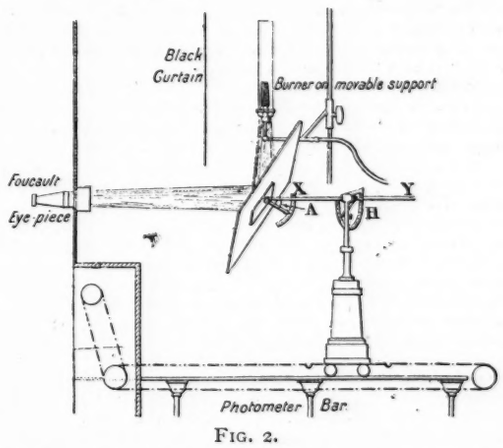


FIG. 2.

Fig. 2 shows how this method is applied. The glass is fixed to a foot standing on the photometer bench. It is inclined at an angle of 45° to the axis X Y, which is parallel to the base, so that the angle of 45° (A) is constant. The glass can turn with X Y; and the angles thus described are measured on the scale H. The photometer, being placed outside the apparatus (facing the glass), can be raised or lowered on a vertical pillar. In proportion as it is raised, it becomes necessary—in order to bring the reflected rays on the lens—to turn the glass. The angle of rotation indicated by H is that which the incident luminous ray makes with the vertical. A black screen prevents the direct rays of the lamp from reaching the lens. For every position of the burner, the quantity of light reflected is measured; and this, multiplied by the coefficient of absorption of the glass, represents the light emitted by the luminous source in that particular direction. This is done for various positions, and a curve of intensities of the illuminant above and below the horizontal is thus obtained.

The "mean spherical intensity" of an illuminant may be defined as the quotient of the sum of the illuminations on a sphere of

unit radius by the surface of the sphere—in other words, the intensity of a point of light which would give the same total of light when emitting luminous rays of equal intensity in all directions. Generally, the photometric surface may be considered as revolving around the geometric axis of the luminous source; and hence, in order to estimate the mean spherical intensity, it is sufficient to study the variations of the intensities in a single meridian plane. The method consists in determining, for inclinations differing by (say) 10°, the intensities of the illuminant, and tracing a curve of the results plotted on any convenient scale.

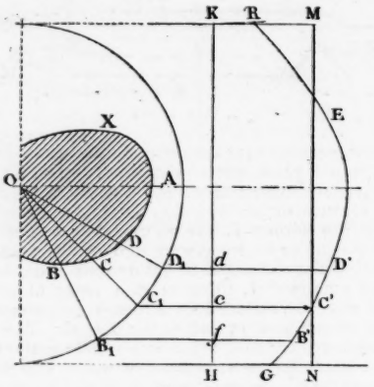


FIG. 3.

The "mean spherical intensity" is deduced graphically as follows. (See fig. 3.) Let O be a luminous source with the photometric curve shown opposite it. Let O A X be the circumference of any given ray. Dividing it into n equal parts by O B, &c., it is seen that by projecting the points D C B . . . on to $d\,c$, and producing the lines so that $d\,D' = o\,D$ and $c\,C' = o\,C$, &c., we get a surface H G E R K proportional to the illumination of the focus in the half meridian under examination; and by drawing M N so that the surface K M N H equals the surface H G E R K, the value of the mean spherical intensity is represented by K M on the given scale.

A knowledge of the photometric curve of a luminous source enables one to calculate the illumination on the ground if the height, h, of the light is known. When an intensity, I, is produced by a luminous source making an angle θ with the horizontal, h distant from the ground, and d distant from the given point P, the intensity at P is

$$\frac{I \sin \theta}{OP} = \frac{I \sin \theta}{h^2 + d^2}$$

When I is expressed in carcels and h and d in metres, the result is in carcel-metres (*i.e.*, such units of illumination that an illumination of n carcel-metres is equal to the illumination produced by n carcels at a distance of 1 metre).

In the case of incandescent mantles, the curves of equal lighting are circles having the foot of the standard as the centre. The plotting of these circles and their combinations, when two or more sources illuminate the same spot, permit of curves of equal illumination being drawn, by which the value of the lighting can be traced, just as curves of geographical altitude fix the contour of a district.

As previously stated, 200 mm. of water was the pressure at which it was decided to use the gas for the high-power lighting. After a study of various compressing methods, an experimental plant capable of treating 50 cubic metres of gas was installed and worked by a motor of half-horse power. This apparatus supplied a main on which were 80 incandescent burners, each consuming 350 litres of gas at a pressure of 200 mm. of water. We could thus study very precisely the burners to be employed. The trials proved satisfactory enough to induce us to use the pressure-raisers for the Champ-de-Mars and Trocadéro gas-lamps. The apparatus has, in fact, the advantage that the pressure depends only on the speed of the machine and the density of the gas which it transmits, and not on the quantity passed. In August, 1899, an order was given for two motors of 1·2 metres diameter, capable of running at a speed of 1050 revolutions per minute, and delivering from 700 to 800 cubic metres of gas, at 200 mm. pressure, per hour. They acted most satisfactorily.

Experiments on reduction of pressure have been carried out since May 1 last with all the burners in use. It has been ascertained that the maximum reduction at the furthest points of the mains has been 18 mm.; so that, by making the pressure at the exhauster 220 mm., we have maintained the necessary maximum throughout the system. The following tables show the influence of pressure on the efficiency of the burner.

The first gives results with burners adapted for the supply of gas at ordinary pressure. Beyond 125 mm. pressure, the simple Welsbach burner gave rise to an unpleasant buzzing. The mantles, also, wear very badly when the consumption exceeds 400 litres of gas per hour.

The second table shows results with the same burners adjusted to 350 litres of gas under 200 mm. pressure. With the pressure approximately 200 mm., the efficiency is very satisfactory, and

Pressure.	Consumption.		Intensity.		Consumption per Carcel.	
	Welsbach.	Denayrouze.	Welsbach.	Denayrouze.	Welsbach.	Denayrouze.
Mm.	Litres.	Litres.	Carcels.	Carcels.	Litres.	Litres.
50	260·87	220·85	18·94	9·56	18·71	23·10
70	300·00	250·00	20·00	12·10	15·00	20·66
75	318·58	266·66	22 59	13·22	14·10	20·17
100	375·00	288·00	34 60	18·52	10·84	15·55
125	413·19	321·42	42·17	23·21	9·80	13·42
150	450·00	346·15	46·91	29·00	9·59	11·94

Pressure.	Hourly Consumption.	Intensity.		Consumption per Carcel.	
		Welsbach.	Denayrouze.	Welsbach.	Denayrouze.
Mm.	Litres.	Carcels.	Carcels.	Litres.	Litres.
50	188·48	9·00	7·21	20·94	26·14
100	248·27	15·50	15·00	16·01	16·55
150	288·00	27·50	27·70	10·47	10·40
175	321·42	33·87	33 80	9·48	9·51
200	349·51	37·24	37·20	9·38	9·39
225	367·35	39·62	39·07	9·28	9·40

the behaviour of the burners very regular. The admission of air must be regulated by using a copper disc, as in the Welsbach burners Nos. 1, 2, and 3.

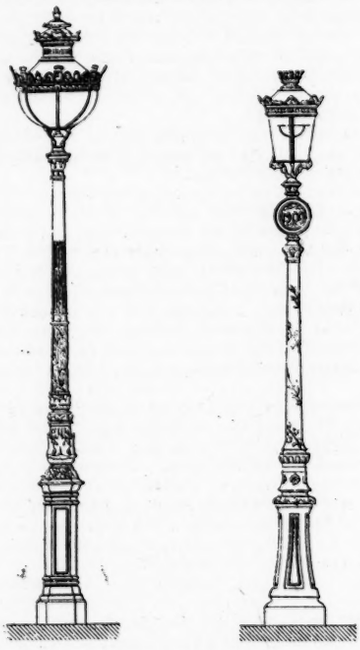
The heat of the burners sometimes oxidizes or burns away the metal gauze; so it is well to use a gauze of rather finer mesh than that in ordinary burners.

The municipal authorities placed at our disposal lamps of the latest pattern, particulars of which are given in the following table:—

Model.*	Consumption of Gas in Litres per Hour (*a*) Before and (*b*) After Alteration.		Diam. of Lower Part.	Diam. of Upper Part.	Height of Chimney.	Height of Lamp.
	(*a*)	(*b*)	Cm.	Cm.	Cm.	Cm
No. 1 .	140	300	21	32	33	65
,, 2 .	140	750	27	39	36	70
,, 3 .	750	750	27	39	36	78
,, 4 .	850	1250	35	45	38	80
,, 5 .	1400	1750	38	49	46	90

* No. 1.—Small refuge-lamp. No. 2.—Ordinary lamp. No. 3.—Ordinary lamp with raised dome. No. 4.—"Quatre-Septembre" lamp. No. 5.—Large refuge-lamp. Lamp No. 1 contained one burner, passing 300 litres of gas per hour; Nos. 2 and 3, three of 250 or two of 350 litres; No. 4, five of 250 or three of 350 litres; No. 5, five of 350 litres.

The lamps were altered by (1) removing the glass covering the base; (2) altering the reflector underneath the upper openings; and (3) making more space in the throat of the lamp, and introducing a cone inside and a cap on the summit of the lamp, in order to prevent water getting inside.



TYPES OF LANTERNS AND STANDARDS EMPLOYED FOR THE INTENSIFIED GAS LIGHTING.

Trials of all the different appliances were made at Landy for a year previous to their installation, with a view to obtaining absolute assurance that the burners worked regularly and that

the number of broken glasses was not too great. These tests were made by placing a thermometer along the windows inside the lamp. Usually the lamps that were not altered showed a rise of temperature of from 180° to 230° C. After alteration, the temperature varied from 70° to 110° C. An extra-large lamp—called the "Opéra"—was designed for centres of great illumination. It permits the introduction of fifteen mantles, each burning 350 litres—say, 5250 litres per hour.

Reviewing the enterprise we undertook, the preliminaries of which have been just described, I may briefly consider the general arrangements adopted.* Compressed gas was used only in great thoroughfares and similar places. The two Farcot compressors were installed on the Quai d'Orsay, each being worked by an 8-horse power gas-engine. Only one was required at a time; the other being reserved in case of accidents. An arrangement of valves permitted the gas to be turned into the second compressor without any fear of the light being interrupted.

An installation on such a considerable scale demanded the co-operation of all interested. The officers of the Mechanical Department were responsible for its general organization; while those of the Mains and Lighting Departments supervised the laying of the supply-pipes and the fitting of the burners in the lamps. The firms of Lecarrière and Co., Mesureur, and Grandpierre also rendered most valuable assistance. The French Welsbach Company and the Denayrouze Lighting Company agreed to bear part of the expenses—viz.: (1) Bandsept burners in the Champ-de-Mars and Denayrouze burners in the Trocadéro. (2) Maintenance and repair of these burners. (3) Renewal of mantles within certain limits. The total help thus received enabled the Company to successfully carry out their scheme; and this lighting of the Parks, the Champ-de-Mars, and the Trocadéro has been in operation since April 3.

It will be interesting to quote the mean illumination afforded in different parts of the area assigned to the Company:—

	Metre-Candles.
Avenues under the Eiffel Tower	28
Central avenue of the Champ-de-Mars	23
Side avenues	26
Château d'Eau	24
Smaller side avenues	12
Central avenue from the Trocadéro	26
Boulevard Delessert	15
Side avenue	22
Bye-thoroughfares	12

The total hourly consumption of gas has been 1,383,900 cubic metres; the total intensity, 91,000 carcels; and the efficiency per carcel, 15·2 litres. The number of lamp standards was 1076, of lamps 1618, of mantles 4619. The area illuminated was 195,000 square metres; 100,000 of which was in the Champ-de-Mars.

Comparing the results with those of 1889, I may here quote M. Fontaine's monograph on the work of the "Syndicate International des Electriciens," in which it is stated that the gardens of the Champ-de-Mars (with an area of 178,000 square metres) were lighted with 19,000 carcels, or a little more than one-tenth of a carcel per square metre. Calculation of the figures previously given shows that the illumination of the Champ-de-Mars has this year been 0·54 carcel per square metre, and of the Trocadéro, 0·39 carcel; or 4·7 times that produced in the Champ-de-Mars in 1889.

The following names must be mentioned among those contributing to the carrying out of the installation: M. Léon Bertrand, M. Chevalier, M. Hart, M. de Mont-Serrat, MM. Vialay and Baron, MM. Saum and Gaudry, and M. Franceschini.

A short time ago we reproduced in the "JOURNAL," from the "Daily News," some extracts from a letter received by Mr. Alfred Colson, of Leicester, from his son, Mr. Douglas F. Colson, who was then serving in the Electrical Engineers (R.E.) Volunteer Corps in South Africa. Mr. Colson, it may be remembered, was taken prisoner, but was subsequently liberated; and he gave in his letter a graphic account of his adventures. His capture was one of the minor "regrettable incidents" of the war; but it was unfortunately followed by blood poisoning which incapacitated him for active service, and he had to go into hospital at Pietermaritzburg. He has since been invalided, and is now on his way home in the hospital ship *Nubia*, which is expected to reach Southampton early next month. As Mr. Colson showed himself to be quick at acquiring the native language and capable of handling gangs of men—qualities which were not unrecognized by his superior officers—it is a pity so promising an engineer was deprived by sickness of the opportunity of exercising them to the fullest extent, and denied the pleasure of returning with his company to receive the congratulations of their compatriots. However, he will be sure to have a hearty "welcome home" at Leicester; and we trust that a period of rest may effectually remove all traces of the mischief which he, like many another brave fellow, has sustained in the service of his country. The current number of the "Electrical Review" contains some snapshots of the Electrical Engineers at work and at play.

* Particulars of the lighting installations at the Exhibition have already been given in the "JOURNAL" (see Vol. LXXV., pp. 1357, 1635, and *ante*, p. 636).—ED. J.G.L.

TECHNICAL RECORD.

THE ANNUAL MEETING OF THE AMERICAN GASLIGHT ASSOCIATION.

The President's Address.

The Twenty-eighth Annual Meeting of the above-named Association was opened at Denver (Colorado) on the 17th inst., under the presidency of Mr. GEORGE G. RAMSDELL, of Philadelphia. Mr. Ramsdell has favoured us with a copy of his Inaugural Address; and we give it below.

We meet at this time, in twenty-eighth annual session, under somewhat peculiar circumstances. Although our Association is national in name and membership, it has never before held a meeting west of the Mississippi river; and it is peculiarly fitting that we have decided to gather here to-day in this thriving city, so thoroughly Western and typically characteristic.

We also meet at a peculiar time, being almost the end of the Nineteenth and on the threshold of the Twentieth Century—a future period, whose possibilities we can only conjecture. When we consider the marvellous advances made in our industry during the past decade, we are prepared to expect wonderful things. I believe the first contract for street lighting with gas in this country was made by the City of New York in 1823. But the gas business was small indeed at that distant period; and it was not until nearly half the century had passed that the business assumed any importance. From then until now, the business has steadily grown, until it has become one of the most stable and important. Its growth in volume, in improved appliances, in economy of manufacture, and in diversity of use, during the past ten years, has been indeed phenomenal; and it to-day survives, after numerous contests of the utmost severity with opponents who, in the gladiatorial arena, would have been classed as giants.

The gas business is a most excellent thermometer of trade, responding with equal promptness to adversity or prosperity; and it seems to me its recent history shows it is keeping pace with our rapid growth as a nation. It is also apparent, I think, that we have reached a point in our history when we must soon drop the idea that we are young in the gas business, and assume the responsibilities of a position in the gas world in keeping with our position as a nation. We already, in some respects, are leaders—conspicuously so in the matter of water gas; and we are very rapidly dissipating the divergence that was formerly so glaring in selling prices. Indeed, very recently, during an important legal action in the City of Boston, it was easily demonstrated that, when the costs of materials and labour were equalized, no appreciable difference existed.

Perhaps the most serious criticism of our business and profession is a lack of thoroughness and repose, largely the result of unavoidable conditions. The growth of the communities we serve has been large and rapid—requiring prompt action and often energetic measures to meet absolute necessities, in order to provide a satisfactory and unfailing supply. This condition is happily passing away. We are advancing in engineering ability quite as rapidly as in other directions; and no change in our business is more marked. The Gas Associations, the educational work conducted by this Association, the technical schools, &c., are responsible for this; and to-day the number of competent minds actively engaged in solving the intricacies of our business is far greater than ever before. I think this is readily apparent in the quality of our meetings—both in the character of papers read and in the subsequent discussion. It is to be regretted that to this cannot be added a statement that there is also a corresponding growth in the number of those who prepare papers or discuss them.

We have been passing through an era of high prices, both in the cost of materials for manufacture and in construction. A year ago the price of oil had increased to such an extent as to become a serious matter, resulting in a large increase in the manufacture of coal gas. Subsequently the price of coal was largely increased, tending to equalize matters. Fortunately for those depending upon coal, a better market had sprung up for residuals; so that, as far as holder costs were concerned, they still maintained about the same relative positions. Already a reaction has set in; and lower prices prevail for both oil and coal.

Undoubtedly, a vast amount of construction work has been postponed, by reason of the abnormal cost of material; and the fact that this character of material has also started downward in price, confirms the wisdom of delay. Indications now point to normal conditions being resumed. Prices will, probably, for some time to come remain higher than formerly; but the margin of difference will not be so great as at the present time. This condition of things will prove exceedingly welcome; for the increased prices of materials fell upon us at a time when reduction in the price of gas was conspicuous all over the country. In fact, there never was a time when the demand for lower rates was greater or more universal. Now that we are getting down to, and below, the "dollar mark" for gas, more attention will have to be paid to the cost of materials entering into its manufacture. The margin for dividends and profits is not elastic enough when gas is being sold at one dollar, or less, per thousand, to stand the strain of an increase in cost of material of from 50 to 100

per cent. It also becomes more and more apparent that, as prices decrease, greater care will have to be taken in our system of accounting; and I deem it of the greatest importance that this whole subject be taken up by the Association, and systematically treated, until a standard is reached. Several years ago the Western Gas Association made a start in this direction, but only carried it as far as the cost of gas in the holder, and the subject has progressed no farther. There seems an urgent demand for intelligent discussion on this particular and important subject; and your officers hoped to have a paper for this meeting, treating the matter, on broad lines, in such a manner as would invite succeeding papers upon detailed subjects. In 1897, I had the honour to prepare and read a paper before the Society of Gas Lighting on "Depreciation;" and I have since been surprised at the number of requests for copies of that paper, for use in legal cases. I mention this simply to call your attention to the urgency for standard rules covering this important field. I, therefore, earnestly recommend that this subject be taken up by us as an Association in a thorough manner, and treated exhaustively. There would be a special desirability, in that it could interest an almost new list of paper-writers—thus "giving labour to the unemployed."

Probably the most prolonged, bitter, and expensive gas war this country has known was ended early in the summer. Other gas wars have reached lower prices, but none where any such amounts were involved. The old prevailed over the new, and the end of the war corroborates the oft-repeated axiom, that "Competition is impossible where combination is possible," and the further fact is emphasized that lower rates in such cases are always temporary in character, and immediately resume normal conditions upon the cessation of hostilities. The war lasted over a year, was waged with unflagging bitterness, and undoubtedly swelled the gas consumption to enormous volume, at unremunerative prices. One of the most noticeable features of this critical period was the remarkable maintained strength of the stocks involved. The final outcome leaves the active lighting interests, both gas and electric, of one of the largest cities in the world in the supreme control of one Company. This is as it should be, although it is unfortunate that the consummation adds unnecessary capital to an already burdensome capitalization, very largely the result of former similar conditions.

For a good many years we have been using, after having formally adopted, the Society of Gas Lighting standard for specials, flanges, &c. This, at the time of its adoption, was the result of a careful investigation on the part of the Committee appointed by the Society of Gas Lighting, and seemed to be a *consensus* of opinion of pipe manufacturers as well as gas engineers. Since the formation of the Pipe Trust or Combination, the pipe manufacturers themselves have taken this matter up; resulting in the adoption by them of a new standard, the principal differences being somewhat heavier specials, and a larger number of bolts used in flange work. I understand they are making, or have made, a system of gang drills, so as to drill any sized flange at one operation; thus very greatly reducing time, labour, and cost. In order to have their flanges suitable for water requirements, the number of bolts must necessarily be sufficiently large for that class of work, which is an unnecessarily large number for gas requirements. The subject seems to me to be entitled to our careful consideration; and I advise its being referred to a Committee for investigation and report.

One of the vital questions of the day is that of public control; and it seems apparent that this important subject will not be satisfactorily settled until a solution is reached, based upon equitable lines, and satisfactory to both sides of the problem.

When the Gas Commission of the State of Massachusetts was established, it was supposed that a satisfactory and equitable solution had been found for gas interests; and it was launched under the most favourable opinion of the gas fraternity of Massachusetts, and, in a large measure, of the entire country. This Commission occupied the position of a judicial referee, to which appeal could be made by either the gas company or the public, with assurance of careful consideration and a fair decision, equitable alike to either party, and one that conserved the best interests of each. The humblest consumer stood on a parity with the largest; and the right of petition, in the hands of consumers, seemed an ever-present reminder both to directors and managers, that secured most respectful treatment and consideration. Starting out in this mutually agreeable way, everything was apparently entirely satisfactory. Many knotty problems were investigated, many equalities adjusted, competition was rendered practically impossible, and, under the control of the Commission, the ledgers of the companies showed prosperous conditions. Undoubtedly, the above conditions have been true for a long period; yet the past year seems to have been fruitful of trouble and vexation alike to the companies and the Commission; and the fact that troubles of an uncommon nature have arisen, after a continued experience, quite the contrary, seems to indicate a weakness in the system. In fact, it seems to show a culmination of conditions long existing, but dormant—the effects of causes possibly hidden, but inherent from the first. A Gas Commission, to be permanently successful, at all times equitable and just to both parties, must be founded upon lines of general policy, that, continuously maintained, will reach correct results. If the general policy be wrong, a gradual divergence will result.

I think the Massachusetts Commission has been composed of fair-minded men, who have laboured to reach correct conclusions, and the fact that for many years no serious complaint has been heard would seem to bear this out. It is but reasonable to suppose, however, that some mistakes have been made, and that, as the entire fabric must be erected upon knowledge gained by experience, the experience of the past year will serve as a guide in formulating or changing any part of the present policy clearly shown to be wrong.

Public control of gas interests, through properly formed and wisely conducted State Commissions, is, to my mind, ideal; and we can well afford to wait for further investigation before arriving at a final verdict. The great value of control by a State Commission was never more apparent than during the period mentioned above; for, while apparently a decision of the Commission started the avalanche of legislation that for a time seriously menaced the vested interests of the Gas Companies of the State, yet it is a conspicuous fact that not one of the Bills succeeded.

The first International Gas Congress, after months of anticipation and preparation, has passed into history. It is probably too soon to fully estimate its results. That it was a success we can safely say; and in my judgment the measure of success surpassed the expectation of its warmest advocates. Being the first attempt at such a meeting, there were no precedents to guide its originators; and therefore the greatest credit is due to those whose foresight and wisdom brought such magnificent results. There was a large attendance, thoroughly representative in character, and intensely interested in the topics under consideration. Even the matter of language did not interfere as greatly as was anticipated. Most of the papers and discussions were in French; but any member was at liberty to express himself in his own tongue. The general arrangements were perfect; and the hospitality of the French Gas Society, under whose auspices the meetings were held, lavish. Under the skilful guidance of the President, M. Th. Vautier, the proceedings moved forward in a most expeditious and satisfactory manner; and the somewhat lengthy list of papers was allotted ample time for discussion. The attendance throughout was very large, drawn from all parts of the globe; the proportion being governed very largely by distance. This country was represented by seven, five of whom were members of this Association; and while a greater number would have been entirely appropriate, yet considering the serious journey involved, we felt proud of our contingent. This Association was complimented (as were all the others) in having your President occupy the chair for a part of one of the sessions.

Great credit is due the Technical Press for their enterprise in obtaining full reports of the proceedings—especially as, at least, three different languages were used during the meetings. Yet, notwithstanding this drawback, the proceedings began making their appearance in the regular channels with as much promptness as though no unusual difficulties were involved. A careful perusal of these reports will show that all the papers presented were of a very high order, and that they were ably discussed. Another feature worthy of notice was that each delegate was given a neatly bound paper pamphlet upon entering the Congress in the morning, giving a complete chronicle of the proceedings of the day before—an evidence that enterprise or "hustle" is not confined to one Continent. The papers presented by our own members were exceptionally well received, and were given the compliment of a liberal discussion.

It was peculiarly gratifying to witness the very great interest taken in Mr. Forstall's paper, giving the history and results of our educational work. That the widest publicity might be given to it, it was read in French; and the discussion was in English and French. I believe no subject presented to the Congress was quite so appropriate for international discussion as this, and none elicited more earnest or thoughtful consideration. The discussion brought out the systems that are in use for the same or similar work in Germany, England, and America, and eliminating the fact that local surroundings may make a wider difference. We have lost no confidence or faith in our system.

In addition to the literary feature, the hospitality of the French Society displayed itself in other ways. The officers of sister Associations, in attendance upon the Congress, were invited to attend the annual dinner of the *Société du Gaz*, which proved to be a delightful affair. The entire list of delegates were also entertained sumptuously on the opening evening of the convention. In addition to this, special attractions were given in the Exposition, particularly in the lighting exhibits, for the benefit of the members; and last, but not least, the entire convention were taken in steamers to visit the Paris Gas-Works.

In the matter of lighting, I think it is within bounds to say that the exhibition of lighting on the Champ-de-Mars is the finest ever given. The Champ-de-Mars is a vast esplanade in the centre of the grounds, and of such ample dimensions as to afford a magnificent opportunity. There were arc and incandescent electric lights, which were distinctly eclipsed by the magnificent display of incandescent gas lighting through the Denayrouze and Bandsept burners, part of them intensified by a pressure plant located on the grounds. There were 4676 mantles, burned under a pressure of 200 millimetres in Bandsept burners, giving 90,000 carcels of light. The average duration of the mantles was 42 days; those in the lamps burning under normal pressure (about equal in number) being about the same. The total light was 4·7 times greater than when the same space was lighted by electricity at the former Exposition, eleven years ago.

Taking the Gas Congress all in all, its connection with the Exposition, where such ample opportunities for exhibition of gas appliances offered, the fact that it was the first of its kind, and the further fact of the opportune time—the close of the Century, which very nearly compassed the lifetime of gas, covering practically the period from birth to its present commanding position—it was a magnificent success. It was the unanimous desire of the English-speaking contingent that a similar congress should some day be held in England or America; and I sincerely hope that when the time comes, circumstances may be such as will give us the honour of holding it in this country.

The three prominent topics of the day abroad are inclined retorts, prepayment meters, and incandescent lighting. In company with two others, I made quite a little study of the first and last of these. The inclined retort, particularly in Germany, has undoubtedly passed beyond the experimental stage, and is occupying a position earned by its merits. We visited fifteen different gas-works during our trip—with one exception, entirely unannounced; so that we visited them as they were running in every-day practice, and consequently saw them to the very best advantage. Of these works, four used only horizontal retorts, eight used inclined retorts exclusively, and three were using both systems. We were received most cordially, and given every facility for acquiring the information sought for; and we desire here to express our heartiest thanks for the many courtesies extended us by the various gas engineers on the Continent and in England, who assisted us in various ways.

Broadly speaking, there can be no question as to the success of the inclined system; the only qualification of the term lying in the adjustment of details. The proper length of retort seems a somewhat unsettled feature. England stands for a length of 20 feet—claiming that they experience no difficulty in heating the entire retort, and readily showing increased economy over retorts of shorter length. On the Continent, they use retorts of shorter length; but it is worthy of note that it is admitted that the earlier installations of 11 feet and 12 feet retorts are too short, and that 16 feet is now considered a more proper length. This fact is emphasized by one of the largest and most ably managed of the companies visited—now using retorts 12 feet long—who, in rebuilding their works, are adopting the 16 feet length. This we found the current opinion in Germany; and as this country has gone into the matter more extensively than any other, and is apparently giving much more study to the subject than any other, it is a criticism worthy of careful consideration. No question can arise as to the nearly automatic discharge of coke from the retort, and no serious difficulty seems to further exist in the preparation and charging of the coal; and as the manipulation of the gas after it leaves the retorts is the same, whether the retorts are horizontal or inclined, it would seem that the mechanical details at least are very nearly complete. At most of the works coal breakers are used; but we visited one where the coal was charged as received, any very large lumps being cracked up with a hammer—the run of the coal apparently being of a size between our nut and lump. In any event, the engineer assured us that it was charged as received, and that he experienced no trouble whatever. The coal used in Germany is largely a mixture of German and English coals, and much of it of the nut size. We heard no complaint of the action of the coal after being deposited in the retort; and the charges we saw, whether at the first or last stage, seemed to lie very even.

In England there is much more talk of the "creeping" of the coal. But it should be borne in mind that our English friends are very much hampered in coal matters, and can do very little in the matter of coal selection at the present; and it seems possible that if they had as favourable an opportunity they might secure a coal that would give as little trouble as the engineers of Germany seem to have.

Another factor worthy of note, it seems to me, lies in the circumstance that the change from the horizontal system to that of inclines is usually so great that it results in most cases in practically new works, doubling or trebling the capacity, and discarding the old for new apparatus of modern type. Hence the whole *ensemble* is conspicuously an improvement upon the old; and unquestionably better results, and greater satisfaction, would be obtained were the retorts on either system. I think due weight should be given to this in considering the merits of the two systems. The cost for labour is approximately the same, using inclined retorts or horizontal retorts, with drawing and charging machines; but the labour troubles strongly recommend the inclined system to foreign engineers.

In our Continental trip we visited the works at Zurich (Switzerland), Dresden, Berlin, Altona, and Cassel (Germany), Copenhagen (Denmark), Rotterdam, The Hague, and Amsterdam (Holland). With two exceptions, all of these were municipally owned. In only one did we see any difficulty in the discharge of coke—arising clearly from local trouble, shown from the fact that we experienced no difficulty in any other of the works. Some little knack is required in charging the coal, but only such skill as an ordinary stoker easily acquires. In some of the works, the duration of charges was four hours; but most of them took six hours. In one works, they had used five benches of nines, 13 feet long, for a year in the same retort-house, with horizontals using drawing machines; and they have already contracted for a complete retort-house of inclines to be 16 feet long, with complete coal and coke handling machinery. This we considered a strong endorsement of the system.

I have purposely refrained from giving figures, for the reason that figures in foreign works would not apply here, and also for the reason that we shall have a paper at this meeting based entirely upon actual practice in our own country. But I give the following conclusions drawn from my observation.

1st. There seems to be nothing in the system of inclined retorts that need be feared as to their successful working.

2nd. The cost of labour is approximately the same per 1000 cubic feet for gas made in inclined retorts or gas made in horizontal retorts using charging and drawing machines.

3rd. There is a marked saving in using inclined retorts, when compared with horizontal retorts operated with manual labour.

4th. The lifetime of inclined retorts would probably be somewhat longer than the lifetime of horizontals.

5th. The first cost of an inclined installation—including all machinery for coal and coke complete—would be more than an installation of the horizontal type, equipped equally well with coal and coke handling machinery, and including charging and drawing machines (works in each case of equal capacity).

6th. Less skill is required to operate a works of inclined retorts than one of horizontals with machines. Hence the freedom from labour troubles is somewhat greater, using inclines, than with horizontals.

Nothing impresses a gasman more in a journey abroad than the well-nigh universal use of incandescent gas lighting. This is particularly true of Germany, where it is said that over 90 per cent. of all gas lighting is on the incandescent system; and I can very readily believe this statement, as it only confirms my own observation. Almost all street lighting, and nearly all indoor lighting, that one sees is of this type, and of very superior quality. The gas companies give far more attention to the burners than is our custom; and it evidently pays to do so. I have seen no streets better lighted, and few as well, as the general run of them in Germany; and this universal use of incandescent burners has produced a marked effect upon the entire gas industry. Candle power has become, or at least is fast becoming, a secondary consideration; and already, in many works, more importance is attached to the testing of gas for its heating qualities than for candle power. It was a matter of note that, in the works we visited, the candle power of the gas was an unimportant factor. It requires no stretch of the imagination to anticipate a time when the photometer will be second in importance, and the calorimeter first. This condition has led gas engineers, in the renewal of all public contracts, to secure the same upon such a basis as will enable them easily to obtain the necessary candle power direct from the coal most economical for them to use. It is therefore not uncommon (especially in Germany) to find street lighting contracts or contracts with cities specifying a power of 13 to 14 candles, measured by the Hefner unit, which, being only 0·877 of an English standard candle, is equivalent to less than 12-candle power, as measured in England.

One of the prime-factors in the liberal use of incandescent lights is undoubtedly their cheapness. There are no patents on incandescent lighting in Germany. Hence a customer can purchase over the counter the best burner in the market, complete with the best mantle, Jena chimney, reflector top, fixed for $1 of our money, and other burners, similarly equipped, for as low as 50 c. After the first purchase, in most of the cities, the gas company thereafter maintains the light, sending out new mantles, with new chimneys, ready to slip on in place of the old one, at a charge of 12 c. in our money. This same outfit can be purchased over the counter for about 8 c. or 9 c.; but the difference is so small that few avail themselves of it, but allow the company's agent to make the renewal—thus securing at all times the greatest efficiency of their lights.

I am informed that the German Continental Gas Company, operating a large number of gas-works, which give abundant evidence of superb management, carry out this system, besides other extremely liberal plans. For example, they have obtained large numbers of new consumers by providing slot or prepayment meters, using the 10 pf. piece, equivalent to about 2½ c. of our money. The only requirement of the consumer is to sign a paper, acknowledging the installation to be the Gas Company's property, which is countersigned by the landlord, if in a rented building. The customer is then furnished free with five incandescent burners, ready for use; a large cooking apparatus, which includes a hot-water heater; a gas-heated ironing set, with two nickled flat-irons of any pattern desired; and burner renewals on the regular terms.

As 10 pf. worth of gas will keep an ordinary incandescent burner going for five hours, this plan has proved very popular—resulting in a large volume of new business. One feature of store-window lighting forcibly impressed me both for number in use and for quality. It consisted of a single or double row of incandescent gaslights on plain iron pipes stretched across the window quite well towards the top. On a single 1-inch pipe there would be placed six, eight, ten, or more of these lights, with a porcelain shade, with nickel trimmings, which not only gave a handsome appearance, but flooded the window with light, and, being located far above the sight line, gave a pleasing effect. I believe this is called the "Ramp" system; and it is not only effective but, judging from its large use, quite popular. It struck me that we were behind our friends on the other side in incandescent lighting, not so much in the quality of the burner itself as in the more effective

way the burners were operated through the better care given them, and consequent uniformity; and, while we are constantly extending their use, they are far in the lead as to numbers. But this state of affairs is most encouraging for us, as we can readily see that the same conditions will sooner or later prevail here. Already with us incandescent gas lighting for streets has become a factor of no mean proportions; and it is easily apparent that there will come a decided increase, and the arc lamp now so largely used, and which created a revolution in street lighting fifteen or twenty years ago, will find a deadly rival in its once vanquished enemy—gas. It seems to me that, as gas engineers and managers, it would be a satisfaction to us if we could express our sentiments on this subject in some tangible way.

If we were asked to-day to whom, as gas purveyors, we are most indebted for our present healthful business condition, I think that we would all, with one accord, answer: "The inventor of the Welsbach light." Launched at a time when gas investment was in its most uncertain period, when the advent of the electric light was proclaimed with such a blare of trumpets as to alarm the large majority of stockholders, and challenge the faith of the strongest friends of the gas business, the Welsbach light entered upon its battle for supremacy, comparatively unheralded, and with an utter lack of all theatrical features. Unfortunately, it did not spring into instant success; and fortunately, it did not sink into utter failure. Unlike the majority of inventions, this light was not the result of chance, but the outcome of the profound knowledge by the inventor of his subject, combined with that superior quality we call genius, which is the embodiment of thought, skill, and persevering labour. After comparative failure for several years, difficulties were gradually overcome, and increased efficiency slowly but surely attained, until to-day, at home or abroad, it undoubtedly stands as the greatest contributor to our present defensive strength, and the strongest weapon we have ever possessed for aggressive warfare. It seems to me an exceedingly appropriate thing to do, and I recommend that Dr. Auer von Welsbach be elected an honorary member of this Association.

In 1879, the writer imported into this country its first large gas-engine. Nothing larger than 7-horse power had been made here. The engine imported from Germany was of 17-horse power. From that day to this, steady progress has been made, until now 650-horse power is, I believe, the maximum manufactured in this country, although there was one on exhibition in Paris of 1000-horse power, which was built expressly to be operated with blast gas from a furnace, and was expected to develop 700-horse power with that poor fuel. We have never enjoyed so large a sale of gas-engines as their merits seemed to warrant; and it is probably to a great extent our own fault. We are at least open to the criticism that we do not entirely practice what we preach. We certainly do not use gas-engines in our works as liberally as we should, and we thereby lose a grand opportunity of advertising them. I believe all motive power about gas-works, except for exhausting machinery, can be furnished by gas-engines cheaper and more satisfactorily than with steam. They are used much more extensively in foreign works than with us—in fact, we visited one works where gas-engines were held in reserve in the exhauster room. However, the development in this country in recent years has been very gratifying; and I am of the opinion that more aggregate horse power of gas-engines has been sold within the last three years than in the ten years preceding. I have been told of one order recently placed for twelve engines of an aggregate horse power of 3000; and it seems entirely reasonable to assume that the number of gas-engines will multiply much more rapidly in the coming years than ever before.

The address concluded by giving some particulars of the life work of eight members of the Association who had died during the past year.

BOILER TRIALS AND ANALYSES OF FUEL AND CHIMNEY GASES.

The following is an abstract translation of a communication prepared by Dr. H. Bunte, of Carlsruhe, at the request of a Committee appointed by the Association of German Engineers, the International Bond of Boiler Inspectors' Associations, and the Association of German Mechanical Engineering Works, to compile a set of rules for carrying out efficiency trials of boilers and steam-engines. It has been published in recent numbers of the "Journal of the Association of German Engineers," and of the "Journal für Gasbeleuchtung."

The rules for trials of the efficiency of boilers and steam-engines compiled and recently published by the above-mentioned Committee showed one important advance in comparison with the rules issued in 1884, which is most significantly stated in Clause 39, which says: "The calorific power of the fuel is to be determined calorimetrically." When the rules were compiled sixteen years ago, opinions were divided on the question of the calorific power of the fuel. On the one hand, it was believed that the interdependence between the chemical composition and the heat of combustion of the fuel was very questionable; while, on the other hand, the methods for the direct determination of calorific power were so tedious and unreliable that a long time would have had to be spent in investigation of these methods, and therefore it was only recommended that the calorific power should be calculated approximately, according to the so-called "Bond" formula. Since that time, however, thanks to the advances in physical chemistry, the methods of making calorimetric investigations have attained such a degree of simplicity, reliability, and precision, and consequently have become so extensively adopted, that a calorimetric determination of the calorific power of a fuel should generally be demanded.

Furthermore, the relation between the chemical composition and the heat of combustion of fossil combustibles has, during the last decade, been to a considerable extent elucidated, whereas opinions on it were formerly very confused. There can be no doubt, from exhaustive researches, that, given a correct ultimate analysis, the calorific power of coals can be determined with a very close approximation to the truth by means of the "Bond" formula, which was recommended sixteen years ago. Approximately correct determinations have been made in this manner for efficiency trials carried out since that date. Following, therefore, a practical suggestion, the "Bond's" formula might be embodied in the new rules, in addition to a calorimetric determination of the calorific power being required.

The greater the reliability and precision of the laboratory examination of the fuel, however, the more important is it that the small quantity of the material tested is truly an average sample of the fuel used in the efficiency trials. But the condition of a fuel such as coal or lignite is so liable to fluctuations, in respect of the amount of water and ash present, that it is by no means easy to secure such a representative sample. The new rules lay special stress on the proper sampling of the fuel. Careful sampling should make it possible to attain conformity between sample and bulk within 1 to 2 per cent. so far as the percentages of water and ash in coal are concerned; but much will depend on whether the conditions are favourable in regard to the size of the coal and the amount of moisture in it. When, however, coals of recent formation and lignites are used, special difficulties supervene, owing to their rapidly fluctuating water-content.

To indicate how great may be the effect on the analysis and the calorific power, tests made by the author some time ago at the suggestion of Herr Münter, of Halle a/S., may here be referred to. A portion of a sample of lignite, packed in a soldered tin, was found to contain 52·5 per cent. of water; other three portions—one similarly packed and kept several weeks, the second put in a well-stoppered glass vessel, and the third in a tin with tight-fitting lid—gave the same result (actually 52·8, 52·6, and 52·6 per cent. respectively). On the other hand, a portion kept for fourteen days in a well-closed wooden box showed only 48·4 per cent. of water; and one kept in a loosely-closed box after nine days 44·5 per cent., and after fourteen days 41·6 per cent. Hence it appears that samples of coal, &c., containing a large amount of water must be conveyed for analysis in soldered tins, or tightly-closed tins or glass vessels, as considerable loss of moisture may ensue if the samples are packed in wooden boxes. Samples on which the percentage of water is to be determined must be stored in glass or tin vessels. The calorific power of the coal would be increased by loss of moisture owing to careless packing of the sample. For instance, the last of the figures quoted would be equivalent to an increase of over 10 per cent. in calorific power.

Loss of water may also ensue in pulverizing and dividing the sample for analysis; and in order to avoid error on this account, it is a good plan to make a rough moisture determination by observing the loss which the sample undergoes when it is exposed to the air for two to eight days. This air-dried sample is then prepared for the subsequent analytical operations. In the cases cited above, the loss of weight in eight days amounted to 30 to 20 per cent., according to the amount of moisture originally present and the size of the lumps of coal. This example directs attention to points to which the greatest care must be paid in efficiency trials, in which it is assumed that a certain percentage of the value of the fuel is utilized in the boiler.

The details of the chemical and calorimetric tests of the fuel need not be discussed here; but it may be pointed out that, for the sake of simplicity in the calorimetric determination, corrections which are of quite minor importance compared with the points referred to above should be omitted in tests made for efficiency trials. For instance, correction for the formation of oxides of nitrogen or of sulphur by combustion in compressed oxygen, and determinations of the nitrogen in the coal, though of scientific interest, may be omitted in such trials.

Calorimetric determinations should be as simple, but as reliable, as possible, because they are coming more and more into use for the regular surveillance of deliveries of fuel in large works, where a chemical laboratory adapted for elaborate operations is not available. In such cases, it will often be necessary to forego the tedious and uncertain determination of the quantity of water produced on combustion, and to apply a constant correction—fixed according to the nature of the fuel—for the latent heat of the water condensed in the calorimetric bomb. The amount of hydrogen—on which this figure chiefly depends—varies only within small limits, so far as coal is concerned. In round figures, it is between 4 and 5 per cent. of the weight of the coal. The quantity of water produced on combustion, therefore, must range between $4 \times 9 = 36$ per cent. and $5 \times 9 = 45$ per cent. of the coal burnt. If the latent heat of the water vapour is taken as equivalent to 600 calories, then for every 1 per cent.

of hydrogen the correction is $1 \times 9 \times 6 = 54$ calories; and consequently for 4 per cent. it is 216, and for 5 per cent. 270 calories per kilo. of coal burnt (98 and 122½ calories per pound).

The majority of ordinary coals used as boiler-fuel contain from 4·5 to 5·2 per cent. of hydrogen, and for such a mean value of 250 calories per kilo. (= 113½ calories per pound) can properly be deducted from the heat of combustion as found in the calorimetric bomb. Actually coal from the Ruhr district contains on the average 4·7 per cent. of hydrogen; while the more recent Saar and Saxony coals contain about 5 per cent., as do also the Silesian coals. The older coals contain also very little moisture—about 2 per cent.—and the more recent true coals seldom contain over 5 per cent. But as each 1 per cent. of water corresponds to 6 calories per kilo., the correction for the water present in coals lies between 12 and 30 calories per kilo. (or 5½ and 13½ calories per pound). But this correction becomes much greater for brown coals or lignites, which may contain as much as 30 to 50 per cent. of moisture. The correction will then be from 180 to 300 calories per kilo. (or 80 to 135 calories per pound). In such cases, it is necessary to determine the amount of moisture in the lignite, in order to arrive at results of value. But when approximate comparative values only are required, the water correction may be calculated in the same manner as for coal for other classes of fuels—*e.g.*, anthracite, coke, &c. For the sake of the economical utilization of our fuels, it is highly desirable that their calorific value should be taken into consideration more than hitherto, and calorimetric determinations afford reliable criteria for the valuation of the fuels.

Only isolated communications have lately appeared on the calorific power and chemical composition of the fuels in common use in Germany. The author has therefore tabulated the results obtained for a large number of fuels, for the most part under his supervision at the Chemical-Technical Testing and Research Institute of the Grand-Duchy of Baden. The source of coal, however, is not of great significance, as it is well known that one group of mines will tap different descriptions of coal, while different mines, on the other hand, will raise the same description of coal. The chief value of the tabulated results (of which an epitome is annexed) lies in the fact that they present reliable values for the chemical composition, yield of coke, and calorific power (determined by the calorimeter) of a large number of samples of coal. Such an exhaustive series of determinations must prove valuable in extending our knowledge of the chemical composition and calorific power of coal. Some general conclusions may, perhaps, be drawn from the results referred to.

Most of the samples examined were good coals, containing but little ash—such as would be selected for efficiency or contractors' trials. The majority of the true coals contain over 90 per cent. of combustible material, or the ash and the water present do not amount to more than 10 per cent. The ash, of course, may vary greatly, according to the quality of the coal; but the moisture in the older coals is very low. In the Ruhr coals, it seldom exceeds 2·5 per cent. In more recent coals from the Saar, Silesian, and Saxony districts, the moisture rises to 10 to 12 per cent., and in the lignites or brown coals to over 50 per cent., without the fuel appearing wet. The proportion of ash and moisture can, consequently, affect the calorific value of these fuels to a much greater extent than can variable quality of the actual combustible substance. For purely practical purposes, therefore, it is indispensable that the percentages of ash and water should be determined, as well as the calorific power by means of the calorimeter.

The true nature of the coal, however, first becomes apparent from the calorific power and chemical composition of the combustible substance in it. In the tabulated results (see Summary) referred to, the calorific power of the combustible substance, calculated from the experimental results, has been recorded for each fuel. This value, after the percentages of moisture and ash have been determined, affords a simple check on the quality of consignments of coal. For extensive works, to which the freight charges form a large proportion of the cost of fuel, this method of controlling the quality of the deliveries becomes invaluable. The author recalls one case in which the price to be paid for the coal supplied has to be calculated on the basis of a fixed price per unit of 100,000 calories. In such a case, both the moisture and ash in the fuel must be kept within narrow bounds, and either washed coal, or briquettes made from such coal, supplied; while there must also not be great variation in the calorific power of the combustible substance of the fuel.

The tabulated results for the true coals, in which carbon forms

COMPOSITION AND CALORIFIC POWER OF GERMAN FUELS.

DETERMINED BY HERREN BUNTE AND EITNER.

SUMMARY (*i.e.*, *the Maximum and Minimum Values in Each Column for the Several Types*).

Type of Fuel.	Composition of the Air-Dried Fuel. (Percentages.)						Percentage of Combustible Substance in the Fuel.	Composition of the Substance of the Fuel, after Deducting Water and Ash. (Percentages.)				Yield of 100 Parts of the Fuel.			Calorific Power of the Fuel in Calories per Pound.*		Calorific Power of the Combustible Substance (Calorimeter Tests), in Calories per Pound.*
	C.	H.	O. & N.	S.	H_2O.	Ash.		C.	H.	O. & N.	S.	Coke.	Solid Carbon.	Volatile Constituents.	Calculated by the Bond's Formula. (†)	Found by the Calorimeter.	
Coals from the Ruhr district, 24 varieties	(*a*) 89·27	5·13	10·52	1·99	2·50	17·87	97·67	91·40	5·43	10·95	2·13	86·16	83·55	28·38	3827	3829	3946
	(*b*) 66·20	3·68	2·74	0·41	0·57	1·63	79·63	82·24	4·12	2·81	0·42	70·08	53·96	13·04	2888	2914	3534
Coals from the Saar district, 11 varieties	(*a* 81·49	5·20	11·30	2·10	4·05	12·46	95·44	85·38	5·65	12·81	2·28	68·59	65·63	37·72	3516	3537	3735
	(*b*) 68·67	4·21	7·90	0·65	1·21	2·83	84·84	80·79	4·93	8·62	0·68	60·21	50·93	29·17	2913	2938	3456
Silesian coals, 6 varieties	(*a*) 81·12	4·85	17·37	1·57	2·28	12·48	94·98	88·64	5·20	18·29	1·84	81·46	74·63	33·86	3467	3468	3883
	(*b*) 70·60	4·24	4·93	0·57	1·58	3·12	85·24	77·91	4·63	5·39	0·61	64·19	58·70	16·89	2965	3006	3169
Saxony coals, 3 varieties	(*a*) 75·95	5·35	11·17	1·80	8·91	5·50	93·10	82·00	5·74	12·00	1·99	(1)59·75	56·23	31·34	3308	3311	3584
	(*b*) 71·45	4·76	9·60	0·63	3·50	3·22	87·57	81·58	5·44	10·55	0·68				3076	3062	3524
Coals from Upper Bavaria, 2 varieties	(1) 58·01	4·42	12·02	4·87	7·37	13·31	79·32	73·14	5·57	15·15	6·14	56·50	43·19	36·13	2551	2551	3240
	(2) 47·78	3·83	10·92	5·24	10·18	22·05	67·77	70·50	5·65	16·12	7·73	55·13	33·08	34·69	2111	2136	3193
Lignites, 8 varieties.	(*a*) 45·40	3·73	17·54	3·87	47·45	15·89	66·09	73·08	6·54	26·54	8·20	38·51	27·61	38·64	1944	1959	3214
	(*b*) 28·80	2·54	9·42	0·99	22·85	1·99	43·76	65·62	4·86	16·89	1·88	24·98	18·11	25·65	1158	1169	2750
Peat, 3 varieties	(*a*) 49·31	4·70	29·18	0·61	29·14	6·91	80·42	63·02	5·84	36·29	0·76	33·16	27·64	52·78	1965	1979	2587
	(*b*) 38·76	3·66	21·27	0·26	14·06	5·28	63·95	57·11	5·72	30·76	0·41	29·60	22·69	41·26	1479	1489	2300
Coal briquettes, 4 makes	(*a*) 83·24	4·45	4·82	1·36	2·10	8·10	91·75	90·94	4·87	5·28	1·48	85·60	77·77	21·89	3551	3548	3933
	(*b*) 80·85	4·05	3·13	0·88	1·06	6·15	90·13	88·55	4·42	3·41	0·98	76·35	69·42	12·63	3476	3455	3789
Lignite briquettes, 7 makes	(*a*) 55·91	4·66	19·14	2·98	19·40	18·52	79·90	71·05	6·09	24·58	4·18	49·40	34·84	45·57	2343	2331	3098
	(*b*) 48·20	4·07	15·21	0·78	10·26	5·33	71·22	67·68	5·09	19·88	0·98	38·92	29·60	40·34	2069	2051	2819
Gas coke, 7 varieties	(*a*) 88·08	1·07	4·80	1·43	3·73	11·18	92·52	96·09	1·22	5·23	1·62	98·30	91·78	3·17	3298	3297	3601
	(*b*) 80·68	0·54	2·01	0·81	0·96	6·41	86·49	92·93	0·60	2·23	0·88	94·34	83·98	0·21	3028	3046	3500

(*a*) Maximum. (*b*) Minimum.

* Calorific power is stated in "calories per kilogramme" in the original paper. The values have been converted into "calories per pound" for the above table. If the "calories per pound" here given are multiplied by 3·968, the corresponding values in "British thermal units (B.T.U.) per pound" will be obtained.

† The "Bond's" formula is: Calorific power = 8100 carbon + 29,000 $\left(\text{hydrogen} - \frac{\text{Oxygen}}{8}\right)$ + 2500 sulphur − 600 moisture.

(1) Determined for only one of the three varieties.

from 75 to 90 per cent. of the combustible substance, show that the calorific power of the coal rises and falls commonly with the percentage of carbon. The percentages of hydrogen and oxygen certainly also affect it. But generally with coals such as are used for heating purposes they do not do so to an extent sufficient to do away with a regular increase of calorific power with the proportion of carbon. The table on next page, in which the calorific powers are arranged according to the percentage of carbon in the combustible substance, for each 1 per cent. variation in the proportion of carbon, illustrates this. The figures in brackets are the numbers of determinations of which the calorific power given is the mean result.

Though it may not be permissible to draw other conclusions from the tabulated results, at least it is clear that they indicate the relation of chemical composition to calorific power in coal, and the preponderating effect of the amount of carbon contained in the coal. For the more recent coals, lignites, &c., the results collected at present do not afford sufficient material for general deductions. No opportunity must be lost of making the necessary chemical examination of such fuels when used in efficiency trials, as only thus will the results acquire a general scientific value, not confined to the case in point.

Chemical observations made during a trial relate to the amount of combustible material left in the residues from the grate, and to the temperature and composition of the furnace gases. The correct determination of the average proportion of carbonic acid in these gases is of the greatest importance, as on it depends the calculation of what is, as a rule, by far the greatest of all the losses of heat, as well as the estimation of the efficiency and economy of the firing. But little change has been made since 1884 in the directions for conducting these observations, except that they are now rather more precise. A simple calculation from the composition of the fuel, and the proportion of carbonic acid in the furnace gases, enables the total volume of

TABLE *showing the Calorific Power of the Combustible Substance of Coals, in the Order of the Amount of Carbon Present.*

Percentage of Carbon in the Combustible Substance.	Calorific Power in Calories per Pound.*				
	Ruhr Coals.	Saar Coals.	Silesian Coals.	Saxony Coals.	Briquettes.
91/90	3882 (4)	..	..	..	3892 (3)
89	3862 (8)	..	..	..	..
88	3823 (7)	..	3883 (1)	..	3789 (2)
87	3796 (5)	..	..	..	..
86	3761 (6)	..	..	..	..
85	3736 (3)	3717 (5)	..	..	..
84	3647 (2)	3687 (4)	..	..	..
83	3642 (2)	3689 (2)	3609 (2)	..	..
82	3534 (1)	3592 (2)	3555 (1)	3584 (1)	..
81	..	3513 (3)	..	3545 (2)	..
80	..	3491 (4)	..	..	..
78	..	3257 (1)	..	..	..
76	..	3290 (1)	..	..	..

* See note to last table.

these gases resulting from a given weight of fuel to be found. The calculation, if made by volume instead of weight, is extremely simple, and affords a direct insight into the course of the combustion, showing the quantity of furnace gases traversing a boiler, their rate of flow, the time they remain in the boiler-flues, the quantity of gas escaping through the chimney, &c. If the carbonic acid is determined at several points in the boiler-flues—for instance, at the back of the fire-bridge, in front of the flue-damper, and at the mouth of the chimney—the quantity of air afterwards drawn in is found in the simplest manner. In this way, in particular cases, want of soundness, and also the causes of bad furnace-draught, are at once detected. Conclusions may be immediately drawn as to the efficiency of the firing, merely from a knowledge of the proportion of carbonic acid and the temperature of the flue-gases; and the relative loss of heat through the hot furnace gases may thus be directly determined. The author has noticed that those concerned make but little attempt to turn furnace gas observations to account in this fashion; and therefore the following particulars are added to illustrate their value.

The proportion of carbonic acid in the chimney gases is a direct measure of the heat produced by the formation of unit volume (1 cubic foot) of the furnace gases. When 1 cubic foot of carbonic acid is formed by the combustion of pure carbon in oxygen or air, 123 calories are evolved. If a furnace-gas contains 1 per cent. of carbonic acid, there have been developed by its formation, for every 1 cubic foot of chimney gases, 1·23 calories. Or, for 5 per cent. of carbonic acid, $5 \times 1{\cdot}23 = 6{\cdot}15$ calories, and for 10 per cent. 12·3 calories, have been liberated. This quantity of heat has heated the gases to a certain temperature, which may be calculated in the following simple manner: The quantity of heat (= W), calculated from the percentage of carbonic acid, is divided by the capacity for heat (= C) of 1 cubic foot of the chimney gases. The expression $\frac{W}{C}$ gives the so-called initial temperature (= T). This temperature thus calculated, for several reasons is actually unattainable. But that fact is of no moment for the present purpose; for T merely serves to afford a simple relation between the quantity of heat produced, and the temperature of the gases at the exit of the furnace, and thus to show the proportion of the heat retained by them. The loss of heat is thus ascertained. If the temperature of the furnace gases issuing from the end of the boiler, and by how much (= t) it exceeds that of the entering air are known, then the fraction $\frac{t}{T}$ directly expresses the ratio of the heat lost through the outflowing furnace-gases to the heat developed. The expression $\frac{T-t}{T}$ then gives the portion of the heat which is expended within the boiler, or the gross efficiency.

The net efficiency, which is given by the evaporation results, differs from the gross efficiency in that it takes into account all losses of heat in the plant through radiation and conduction. But as these latter losses do not fluctuate much for the same plant under similar conditions, the above calculation will serve, not merely as a control on the stoking, but to a certain extent as a control of the work done by the boiler. Thus the proportion of carbonic acid in, and the exit temperature of, the furnace-gases afford important starting-points for criticizing a boiler plant, just as indicator diagrams are of service with steam-engines. They enable surveillance to be exercised in the ordinary course of working, apart from more exhaustive efficiency trials.

The utility of the procedure just described is apparent with any carefully conducted efficiency trial, for which the proportion of carbonic acid and the exit temperature have been correctly determined. To facilitate the calculation, the annexed table has been compiled, in which, for furnace gases containing from 1 to 16 per cent. of carbonic acid, the capacity for heat (= C), as well as the initial temperature (= T), are given, for both pure carbon and for ordinary coal, each burnt in air. The products of the combustion of coal contain water as well as carbonic acid and atmospheric constituents; and the initial temperature is higher than with pure carbon. There is, however, but little difference in the value T for all natural fuels; and the values given in the table for coal may be taken as applicable to all classes of coal. The calculation was actually made for coal of the following composition: Carbon 84·45, hydrogen 5·43, oxygen 8·18, sulphur 0·75, nitrogen 1·16 per cent.

Percentage of Carbonic Acid in the Furnace Gases.	Capacity for Heat of One Cubic Foot of the Gases = C.	Initial Temperature (Degrees Centigrade) $\left(\frac{W}{C}\right)$ for		Difference for 0·1 per Cent. of Carbonic Acid.
		Carbon (T).	Coal (T).	
1	0·00873	141	167	16
2	0·00877	280	331	16
3	0·00880	419	493	16
4	0·00883	557	652	15
5	0·00886	694	808	15
6	0·00889	830	961	15
7	0·00892	962	1112	15
8	0·00895	1096	1261	15
9	0·00899	1229	1407	14
10	0·00903	1360	1550	14
11	0·00907	1490	1692	14
12	0·00911	1620	1830	14
13	0·00914	1750	1968	13
14	0·00916	1880	2102	13
15	0·00918	2005	2237	13
16	0·00920	2130	2366	..

The utility of the above-described method of calculating the loss of heat may be shown by examples. Take, for instance, the carefully conducted boiler trials at the Electrotechnical Exhibition at Frankfort-on-Main, to which Nos. I. to VI. in the annexed table refer; and trials made by the Prussian Smoke Abatement Commission, Nos. VII. to IX. In the Frankfort trials, Ruhr coal was used, in Trials VII. and VIII. Silesian coal, and in Trial IX. Bohemian lignite.

Trial.	Excess of Temperature of the Furnace Gases t.	Percentage of Carbonic Acid in the Furnace Gases.	Initial Temperature (from the Percentage of Carbonic Acid by the foregoing Table) T.	Percentage Loss of Heat by the Furnace Gases.	
				Calculated $\frac{t}{T}$.	Found in the Efficiency Trials.
	Deg. Cent.		Deg. Cent.		
I.	287	11·9	1830	15·6	16·07
II.	286	8·3	1306	22·0	22·62
III.	304	9·7	1512	20·1	20·82
IV.	261	9·8	1547	17·1	17·71
V.	286	10·7	1655	17·3	17·73
VI.	260	12·8	1940	13·9	13·52
VII.	216	8·9	1383	15·6	15·41
VIII.	213	10·5	1620	13·1	12·57
IX.	216	8·2	1291	16·7	15·96

The table shows that the abbreviated method gives good results, even with very different kinds of fuel. The relative loss of heat through the furnace gases and the gross efficiency can therefore be ascertained merely by determining the exit temperature of, and the proportion of carbonic acid in, the furnace gases, and without a knowledge of the chemical composition and calorific power of the fuel. This is a valuable practical advantage, as complete efficiency trials are costly and difficult.

The worst part of the chemical investigation consists of the determination of the unconsumed constituents—carbonic oxide, hydrocarbons, and soot—of the furnace gases. Our knowledge of the losses which happen through incomplete combustion is still extremely imperfect. In general, the type of fuel is of great importance—for instance, the amount of its constituents volatilized by heat. It is therefore rightly recommended that a coking trial should be made to determine the quantities of volatile matter, and of residual coke. But other points are of equal importance—viz., the type of grate, the stoking, and other local and temporary conditions. Therefore these losses can only be properly investigated in any case by an exact testing of the furnace gases. The usual gas-analysis appliances—such as burettes and Orsat's apparatus—only give sufficiently reliable results for the carbonic acid; and they do not serve for determining the unconsumed gases. As a rule, only carbonic oxide can be determined by such apparatus, and the other combustible constituents have to be ignored; while the errors are too great for so highly diluted gases.

A percentage of 0·2 by volume of carbonic oxide in furnace gases, which is as little as can be determined with any precision by such analytical apparatus, is equivalent to 0·17 calorie per cubic foot of the gases. The error, assuming that 1 lb. of coal produced (say) 250 cubic feet of furnace gases, would consequently amount to $250 \times 0{\cdot}17 = 42{\cdot}5$ calories per pound of coal. The rules therefore require the composition of the gases to be determined by exact analytical methods, wherever loss by incomplete combustion is investigated. For such determinations, a very suitable method is the combustion of from 6 to 10 litres of the gas by means of cupric oxide, and estimating the carbonic acid and water produced as in elementary analyses, and then determining the soot separately. Up to the present, such tests have rarely been made; but they are the only ones suitable for trials of the efficiency of so-called smoke-consuming firing. The loss of heat by unconsumed gases and smoke can be very great

PREPAYMENT METERS.

CHANGING PRICE.
MOST SIMPLE.
NO WHEELS OR
PARTS REQUIRED.

THIS METER CAN BE ALTERED *in situ.*

INSTRUCTIONS.

The Brass Plate has holes around its edge, numbered; these indicate the feet delivered for the Coin used
To set the Meter, note Figs. I., II., III., IV.

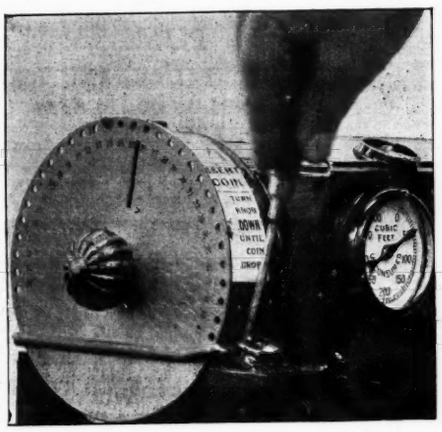


Fig. I.
Break Company's Seal and Remove Screw—THUS.

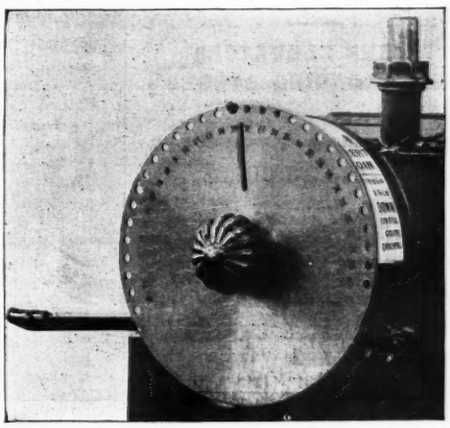


Fig. II.
Swing Band Back—THUS.

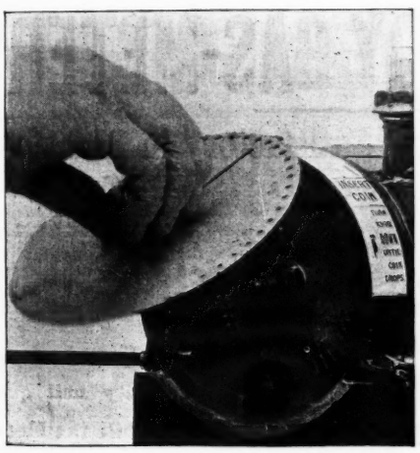


Fig. III.
Lift Plate Off—THUS.

Fig. IV.
Replace Plate—THUS.

Swing Band Forward—Replace Screw—and Re-seal.

NOTHING SO EASY. NOTHING SO ACCURATE.

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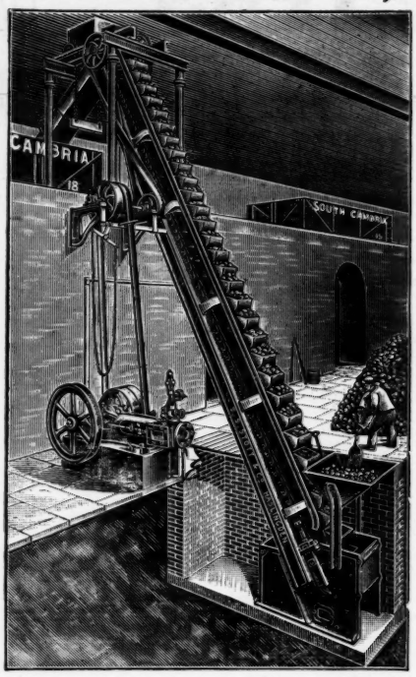

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HIGH-CLASS STEAM-ENGINES up to 1000-Horse Power.

PUMPS, HORIZONTAL AND VERTICAL, SINGLE, DOUBLE, or THREE-THROW, for WATER-WORKS, &c.

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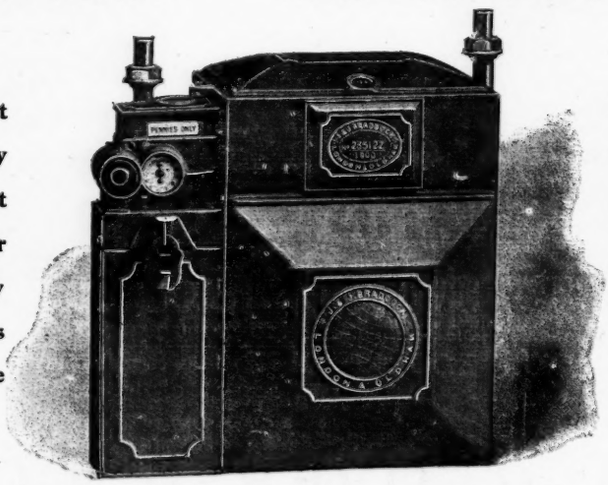
BRADDOCK'S PATENT PENNY-IN-THE-SLOT

(ALSO SHILLING-IN-THE-SLOT)

PREPAYMENT WET AND DRY GAS-METERS.

Very Strong and Reliable. Durable and Satisfactory in Practice.

The Attachment does not form part of the ordinary Meter Index, and need not be taken off if the Meter had to be repaired at any future time. Hence repairs are not rendered more difficult.



The Patent Crown-Wheel Arrangement for enabling the feet allowed per penny to be easily and quickly altered while the Meter is *in situ* is most convenient, definite, and satisfactory. Any number of feet per penny may be allowed.

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THIS ATTACHMENT IS APPLICABLE TO ANY SIZE OR KIND OF GAS-METERS.

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with smoky firing; and therefore it is most desirable that testing should be more generally adopted.

Very little satisfactory information is to be gleaned from published matter on the amount of such loss. The only extensive series of researches of which the author is aware, on loss by incomplete combustion of furnace gases, was made at the Munich Heat-Testing Station twenty years ago. It included 52 experiments with various descriptions of ordinary coal, on a horizontal grate. The unconsumed gases and smoke were determined, and the loss of heat therefrom calculated. In 25 cases the unconsumed gases caused the greater part of the loss of heat; in the remaining 27 the loss due to the smoke was the greater. Roughly, therefore, about half is due to visible and about half to invisible losses. The total loss of heat from these causes in 51 trials was as follows: In 11 cases 0 to 2 per cent. of the calorific power of the coal, in 9 cases 2 to 3 per cent., in 13 cases 3 to 4 per cent., in 6 cases 4 to 5 per cent., and in 12 cases over 5 per cent. Excluding instances in which the conditions were clearly unfavourable, on account of the great depth of fuel, insufficient draught, clinker on the grate, &c., it was found that in 40 cases with smokeless firing the loss of heat through the gases and smoke did not exceed 5 per cent. In most instances careful stoking afforded tolerably complete combustion, with 8 to 10 per cent. of carbonic acid present, with a comparatively small supply of air. Far greater losses, however, appeared when the bed of fuel was of great depth, or the draught insufficient. To show how great these losses may be, the following results of heating trials of six to ten hours' duration with Saar coal are given:—

Trial.	Composition of the Furnace Gases. (Percentages by Volume.)					Loss by Non-Combustion in Percentages of the Calorific Power.		
	CO_2.	CO.	H.	O.	N.	By Gases.	By Soot.	By Gases and Soot (Total).
I. . .	14·62	2·07	1·00	2·07	80·25	10·7	6·7	17·4
II. . .	14·29	0·85	0·60	3 20	81·06	5·5	4·8	10·3
III. .	14·01	0·62	0·19	3·92	81·26	3·2	2·5	5·7
IV. .	10·22	0·22	0·07	8·57	80·92	1·6	1·8	3·4

Conditions of the Trials.

I.—An 8-inch bed of fuel; indifferent draught; clinker on fire-bars.
II.—A 6-inch bed of fuel; but in other respects as No. I.
III.—A 5-inch bed of fuel; stronger draught.
IV.—A 4-inch bed of fuel.

The loss in the first trial, with very smoky firing, amounted to 17·4 per cent. The broken coal was added and distributed uniformly over the grate every 15 minutes. Reduction of the depth of fuel reduced the loss to 10·3 per cent.; while in the third trial, more frequent stoking—the small coal being added at intervals of 7½ minutes, and spread over the front part of the grate—with the help of a stronger draught, resulted in a further reduction to 5·7 per cent. A somewhat greater excess of air brought down the loss to 3·4 per cent. Although the unfavourable conditions of the first two trials would scarcely ever occur in efficiency trials, yet they indicate how great the loss through unconsumed gases and smoke may be if the arrangements and stoking are bad, and incidentally the great value of an exact examination of the furnace gases. It is highly desirable that such examinations should be more frequently made, especially in cases where the performances of special grates or so-called smoke-consuming furnaces are in question.

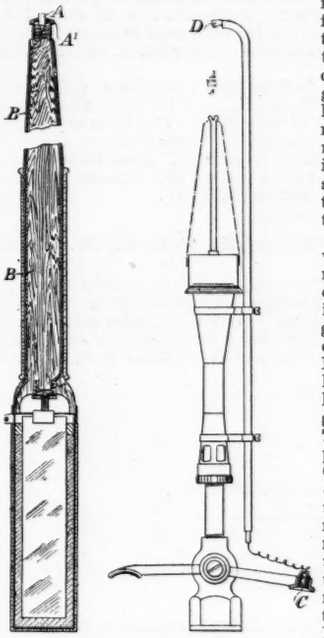
Paris Gas Company.—The revenue of the Paris Gas Company for the month of June last was 5,535,311 frs. (£221,412), as compared with 4,959,590 frs. (£198,383) in June, 1899; being an increase of 575,721 frs. (£23,029), or at the rate of 11·61 per cent. These figures brought up the revenue for the first half of the year to 43,886,362 frs. (£1,755,454), as compared with 40,454,427 frs. (£1,618,177) in the corresponding period of 1899; being an increase of 3,431,935 frs. (£137,277), or at the rate of 8·48 per cent.

Fatality at the Beckton Gas-Works.—The Coroner for West Ham recently held an inquest on the body of Edward Page, aged 26, a labourer in the service of the Gaslight and Coke Company at Beckton. Alfred Arrowsmith said he was engaged with deceased in hoisting baskets of chalk to the top of a lime-tower, from which it descended to the pit. Page was at the top and witness at the bottom; and about half-past three, after Page had been nearly 1½ hours on the tower, witness heard a shout for someone to come and help a man up. Going round he found deceased at the bottom of the ladder of the tower bleeding from the head. There was a rail on the tower 3 feet above the top. He had felt a little sick once or twice when he was working at the top of the tower, and the fumes were blowing in his face. William Hammersley, the foreman, said flue gases were present when the top of the kiln was opened, but there had never been any complaint by a man who had worked on the top. Dr. W. G. Ross, of the Seamen's Hospital, said the deceased was admitted suffering from fracture of the skull, and in a dying condition. He succumbed in half-an-hour. There was no symptom of gassing. Mr. Ireland, one of the Inspectors of Factories, said that in almost every departmental report the fact that one rail was not sufficient was drawn attention to. He did not consider that a single rail was sufficient safeguard. The Jury returned a verdict of "Accidental death;" adding a rider that they considered there should be better protection at the top of the kiln.

REGISTER OF PATENTS.

Electric Lighter for Incandescent Street-Lamps.—Duncan, J. H. H., of Coleman Street, E.C., the New Sunlight Incandescent Company, Limited, of Shoe Lane, E.C., and Barnett, H. T., of Teddington. No. 19,193; Sept. 23, 1899.

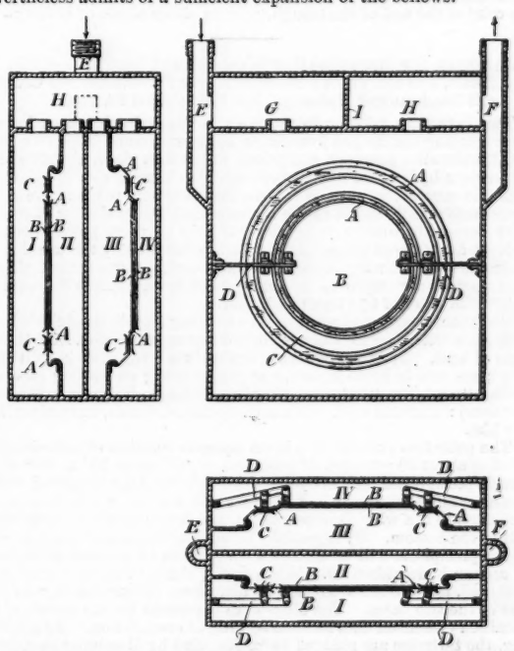
This invention has for its object to enable gas-jets to be ignited by a single source of electricity of low potential. The electric generator and the tap by means of which gas is turned on to a burner, are provided with contacts so arranged that the electric generator contacts can be forced against the tap-contacts for the double purpose of turning the gas-tap and at the same time completing an electrical circuit including the electric generator and a portion of a kindling device, so arranged in relation to the burner as to be near to, or in, the jet of gas issuing from the burner, and adapted to be highly heated on the passage of an electric current through it.



An example of the apparatus when adapted for use in connection with street lighting by incandescence gas-lamps, is shown in the engraving. The electric generator A A¹ contacts are carried by the upper end of a rod B, which constitutes part of a lamplighter's torch, and at the lower end of which the electric generator (a dry cell) is placed. The tap-lever of the burner is provided at one end with contacts C, shaped to suit the torch-contacts respectively. One of the tap-contacts is attached to the metal of the tap-lever; and current passes through it, through the metal-work of the burner and the clamps on it, and through a metal tube held in the clamps, to one end of a fine kindling wire, D. After traversing this wire, the current flows through a short length of thicker platinum, through an asbestos-insulated wire, to the contact C, which is insulated from the tap-lever.

Gas-Meters.—Jensen, H., of Hamburg. No. 21,338; Oct. 25, 1899.

In dry gas-meters as heretofore known (says the patentee), the extensible walls of the chamber are mostly made of leather folded in the form of bellows. The disadvantages of this arrangement are that the membranes easily become altered—that is to say, they extend sometimes more and sometimes less, and also soon become cracked or split—and in view of this fact, the patentee has sought to lessen the disadvantages by reducing the membrane surface, replacing these latter by solid central plates connected to the wall of the measuring-chamber by a broad ring of fabric. This type of measuring-chamber, it is claimed, is considerably improved according to the present invention, inasmuch as the flexible material (or membrane-surface) only forms a narrow flexible ring which "nevertheless admits of a sufficient expansion of the bellows."



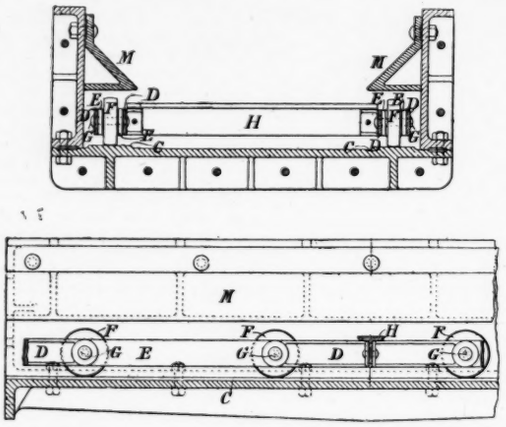
As shown in the engravings, the membrane of the bellows is fitted on both sides with centrally-arranged plates B; and, in addition, a number of rings C surround the plates, and, if desired, are also placed around one another as far as the size of the membrane will allow, by leaving narrow

annular spaces between the solid plates and the rings respectively. The plates and rings are thus connected together, so to speak, by narrow annular strips A of flexible membrane, which permit of the bellows-movement of the walls of the measuring-chambers I., II., III., and IV. The circular link-arrangement of the flexible walls, by means of alternate solid plates B or rings C and flexible rings A, "constitutes the improvement and the novel feature of the arrangement; while the bellows itself is of the usual form, and capable of pulsating in each direction without appreciable inaccuracy." In order to prevent undue stretching (beyond a certain limit) of the annular hinge-joints A on the pulsations of the bellows, it is advisable that the central plate B, which in gas-meters is usually guided at the middle, should be connected to the rings C, by means of lever-links D adapted to maintain the rings in proper position with regard to the central plate, so that the narrow flexible rings A cannot be overstretched.

In the form shown, the meter is fitted with two bellows, thus constituting four measuring-chambers I., II., III., and IV. in connection with inlet and outlet chambers G and H for the gas. The latter are formed by a partition-wall I dividing the top space into two chambers G and H, provided with an inlet E and outlet F respectively. From the chambers suitable openings (controlled by valves) regulate the entrance into, and the escape from, the measuring-chambers I. and IV.

Conveyors for Hot Coke.—Graham, M., of Leeds. No. 24,659; Dec. 12, 1899.

The patentee employs a cast-iron trough, made in sections of suitable length, width, and depth; each section being preferably built up with sides, and a renewable bottom-plate, having raised roller-paths C cast thereon. Upon these raised paths runs a double endless steel chain, each side of which consists preferably of double links D E, rollers or



runners F, and pins G. The chain carries, at suitable intervals, detachable and renewable steel ploughs H (preferably of T-section), for drawing the coke along the trough; the ploughs being attached by pins or rivets in slotted brackets formed on the links. Overhanging deflecting plates M are provided, to protect the chain from the falling hot coke; the plates being also renewable as required, and being attachable either to the sides of the trough or to the top flanges. The chain, after delivering the coke at the end of the trough, returns either above or below it.

Substances for Impregnating Incandescent Mantles.—Pink, L., of Berlin, and the Vulkan Gesellschaft für Selbstzündende Glühkörper mit Beschrankter Haftung. No. 7933; April 28, 1900.

This invention, relating to the manufacture of substances for use in impregnating the fibrous foundation of incandescent bodies or mantles for illuminating purposes, comprises, in the first place, a process of treating cerium hydroxide, whereby two metallic bases are obtained, either of which is capable, when used alone—that is to say, without the other in combination with thoria in the manufacture of mantles for illuminating purposes—of producing "a greater radiancy or more powerful emission of light for a longer period of time than obtainable by the usual mixture of thoria with ordinary or usual ceria;" and, in the second place, the manufacture of "improved incandescent bodies or mantles" by combining one or the other of two bases with thoria.

The process essentially consists in treating freshly precipitated cerium hydroxide with solutions of certain bi-basic organic acids, with the assistance of heat. By this treatment, the cerium hydroxide is split up into two bases, not hitherto known, one precipitating on cooling as a salt of the acid used, the other remaining in solution. Suitable acids are (for instance): Tartaric acid, malic acid, chloracetic acids, succinic acids, and the like.

The patentees purpose to mix an aqueous solution of tartaric acid containing about 30 per cent. of acid, and heated up to 75° to 80° C., with freshly precipitated cerium hydroxide, which is readily dissolved, and allow the clear solution to cool. The liquor will become turbid, whereby it has imparted to it a whitish appearance; and finally a white precipitate will fall to the bottom. By repeatedly re-heating and re-cooling, the quantity of the precipitate will be increased up to 35 to 40 per cent. of the amount of cerium hydroxide used. When finally the maximum of precipitate is obtained, the two are separated by filtration. It consists in a tartrate of one of the two bases. The other base is present in the solution, and is obtained therefrom as a tartrate by way of evaporation. By gentle heating, the tartrates are reduced to oxides; and by dissolving in nitric acid, they are transformed into nitrates. By dissolving the oxides in other acids, the corresponding salts are produced. The metallic base contained in the precipitate the patentees call "phosogenium" or "phoson;" and the metallic base in solution they call "lucogenium" or "lucon."

The new bases, or split-off products, obtained in the manner described, can readily be distinguished from each other and from ordinary ceria by the different proportion of oxide present in their tartrates; by the different resistance opposed by their nitrates to decomposition; and by their different crystallization and behaviour towards certain reagents. The tartrate of lucogenium contains 42·5 per cent. of oxide; while the tartrate of phosogenium yields 36 per cent. of oxide. Lucogenium tartrate is obtained as a dry crystalline powder, whereas phosogenium tartrate is in the form of rhombic crystals, which are deliquescent. Lucogenium oxide proves to have a by far greater binding power for nitric oxide than phosogenium oxide, of which the nitrate, when exposed to a gentle heat, swells up to about twenty times its original volume, emitting reddish-brown fumes. When ammonia is added to a solution of lucogenium nitrate, a white coloured precipitate is obtained; whereas with a phosogenium nitrate solution, even an excess of ammonia will not cause a precipitate to form, and with a cerium nitrate solution a precipitate is produced which shows a colour varying from yellow to dirty brown.

When malic acid is employed, a higher temperature should be applied than with tartaric acid. The malate of lucogenium is not precipitable from its solution by means of ammonia. Ammonia oxalate causes the solution to become turbid; the original clear condition of the liquid being re-established by the addition of an excess of the oxalate.

When chloracetic acids are used, the solution becomes turbid after twelve hours boiling on a sand-bath, using a reflux cooler. The reaction is complete when at least 98 per cent. of the quantity of chlorine as calculated has disappeared, which is determined by means of a standard solution of argentic nitrate to which is added potassium chromate to serve as indicator. The nitrates prepared from the salts produced by this reaction are difficult to crystallize. It is, however, possible to cause them to crystallize out by dissolving them in an equal volume of water, and mixing this solution with alcohol—using, for instance, as much alcohol as quintiple the volume of water. In like manner, the same effect will be obtained by boiling the cerium hydroxide with succinic acid.

As already stated, the bases produced from cerium hydroxide in the manner described are more advantageous for manufacturing incandescent mantles than ceria, provided they are not used together, but each separate from the other—that is to say, so that the thoria mantle is manufactured either with a lucogenium compound or with a phosogenium compound. The use of either of these new compounds is said to result in incandescent mantles which show "a by far higher radiancy, and retain their maximum of light emission for a longer period of time, than the ordinary ceriated thoria mantles are capable of, even when manufactured with the utmost care and with fabrics as free from sicilic acid as possible." The candle power obtained is said to be beyond 100; and the mantles have been "proved to retain this power for more than 300 hours."

The new compounds may be used in quantities from 1 to 16 per cent. of lucogenium nitrate, and from 1 to 8 per cent. of the phosogenium nitrate, according to the shade desired for the light. For manufacturing incandescent mantles, either a lucogenium compound or a phosogenium compound (preferably the nitrate) is added to a solution of thorium nitrate, and the fabric impregnated with the compound solution, dried, and burnt—all as usual with the ordinary thoria-ceria fluid. The best results as to candle power, life, and radiancy of mantles are claimed to have been obtained with lucogenium nitrate in the proportion of 4 to 8 per cent., and phosogenium nitrate in the proportion of 1·5 to 4 per cent.

Suspension Lamps, Chandeliers, &c.—Kemp, C. W.; a communication from W. Fahndrich, of Hamburg. No. 3009; Feb. 15, 1900.

This invention relates to suspension gas and other lamps, chandeliers, and the like; and (in the words of the patentee) it has for its objects (1) to so arrange the metal-work above the lamp that the same shall come clear of the ascending fumes—thus preventing the discoloration of the same; (2) to obtain an artistic appearance in gas-lamps to imitate (in a measure) the dropping effect of incandescent electric lights; and (3) to entirely or partially enclose or conceal from view the depending gas-pipes and the metallic fittings incidental to the supply of gas to the burner and the supporting of the chimney. The arrangement here referred to was described and illustrated in the "JOURNAL" for Oct. 16, p. 950.

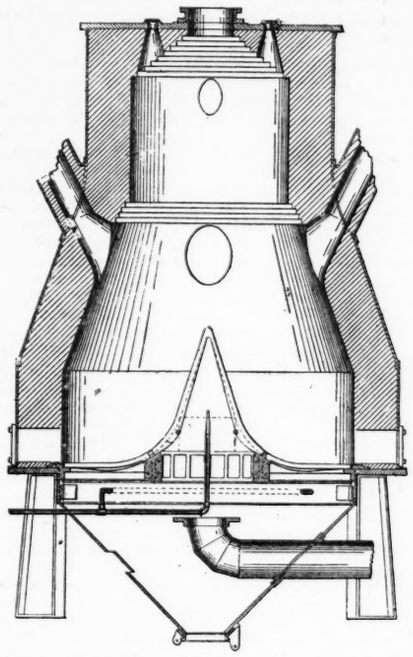
Manufacture of Water Gas.—Slocum, F. L., of Pittsburgh, U.S.A. No. 12,335; July 7, 1900.

The patentee claims an "improvement in the art of making water gas," consisting in "providing a wide, shallow body of ignited fuel superposed by a narrow body of unignited fuel, passing air in upward and diagonal outward courses through the body of ignited fuel in such quantity as to ensure the production of a major portion of carbonic acid, and subsequently passing steam in upward course through the ignited and incandescent fuel, and the gases produced upwardly through the unignited fuel."

In practising the invention, the patentee says it is preferred to employ bituminous coal, "for the reason that a large proportion of the hydrocarbons contained therein can be saved and carried off with the water gas generated, while but little of the same are wasted in connection with the blasting-up of the mass." The apparatus illustrated is considered the best suited for the practice of the method, especially in connection with the use of bituminous coal.

The generator-body is supported on suitable standards holding a bed-plate, on which the shell and the brickwork of the generator rest. The shell has a lining of brickwork, having a vertical portion extending up a short distance above the grate, and an upwardly converging or downwardly flaring portion leading up into the narrow vertical fuel-feeding portion. At or near the top of the converging portion are several blast-outlets—the drawing showing three of the four used with the type of furnace described. The number depends on the size of the generator. The outlets are arranged around the generator, so as to give free exit to the products of combustion from the wide body of fuel in the lower part. In the upper part is the gas-outlet, while the top of the generator is provided with the poke-holes and the fuel entrance, which are, of course, closed in any suitable way. In the lower part of the generator is arranged the grate above referred to, which is supported on cross-beams, and has a wide grate expanse, as illustrated, having a conoidal central grate portion extending up centrally of the generator, so as to increase the grate-surface, and provide for the distribution of the air throughout the mass of coal in the wide shallow base of the generator. As illustrated,

this conoidal grate portion rests on a ring supported on beams; the ring giving support to the lower ends of the grate-bars forming the conoidal central portion, and the inner ends of the grate-bars which extend from the ring to the outer wall of the generator. The lower portion of the generator has a closed ash-pan with a discharge-door, and an entrance-pipe for the air-blast. The steam-pipe enters through the ash-pit; and,



in order to distribute the steam quickly to the incandescent fuel in the lower part of the generator, a perforated ring-pipe is employed, extending around about mid-way of the horizontal grate portion, and also a central steam-pipe rising within the conoidal grate—"it being found that by such construction the steam is discharged from the steam-pipes close to the fuel, and rises quickly so as to pass into the same."

APPLICATIONS FOR LETTERS PATENT.

18,295.—Clayden, A. W., "Gas-engines." Oct. 15.
18,321.—Nicholls, R., "Improvements in gas lighting." Oct. 15.
18,340.—Abel, C. D., "Internal combustion motors." A communication from Allgemeine Gesellschaft für Dieselmotoren, A. G. Oct. 15.
18,353.—Chauvin, E. L. H., "Acetylene gas-generators." Oct. 15.
18,358.—Poliakoff, J., "Light measuring or calculating apparatus." Oct. 15.
18,365.—Foulis, W., "Charging and drawing retorts." Oct. 15.
18,370-1-2-3.—Schreiner, L., and Michaux, G. E. N., "Explosion motors." Oct. 15.
18,378.—Enckevort, A. H. E. von, "Acetylene generators." Oct. 15.
18,399.—Blakey, J. W., "Gas-heated laundry irons." Oct. 16.
18,428.—Bowley, J. W., "Lamps." Oct. 16.
18,489.—Wilson, P. J., and Wormald, A. H., "Taps and valves." Oct. 17.
18,499.—Deimel, F., "Self gas lighter." Oct. 17.
18,502.—Walser, C., and Cartier, T., "Acetylene gas apparatus." Oct. 17.
18,503.—Scharfberg, M. R. M., "Apparatus in connection with water-mains." Oct. 17.
18,527.—Forbes, Sir C. S., "Carburetter." Oct. 17.
18,559.—Green, S., "Automatically extinguishing lamps." Oct. 18.
18,567.—Simpson, S., "Gas cooking-stoves." Oct. 18.
18,577.—Marland, W. W., and Large, E., "Prepayment gas-meters." Oct. 18.
18,587.—Levetus, E. L., "Acetylene generators." Oct. 18.
18,602.—Nelson, M., "Moveable gas-shade." Oct. 18.
18,621.—Holub, B., and Dvoracek, R., "Producing acetylene gas." Oct. 18.
18,642.—Schodt, P. G. de, "Low-pressure incandescence lighting." Oct. 18.
18,674.—Beggs, D. C., and Fielding, W., "Generation of acetylene gas." Oct. 19.
18,699.—Kuhn, C., "Acetylene generators." Oct. 19.
18,740.—Smith, R. H., "Pilot lighter for street and other lamps." Oct. 20.
18,747.—Proctor, B. S. & H. F., "Meters for water or other liquids." Oct. 20.

Bangor (Co. Down) in Darkness.—On the night of the 17th inst., the piston-rod of the exhauster engine at the Bangor Gas-Works broke; and this threw the exhauster out of use. The Manager (Mr. R. Gault) tried to keep up a supply of gas without it during the repairs; but the ascension-pipes became choked, and manufacture was stopped. A fair quantity of gas was sent out till Saturday, and then it had to be curtailed. On Sunday, the 21st, most of the churches were lighted with paraffin oil and candles; but the parish church could not be opened for evening service. It appears that the present works are altogether inadequate for the supply of the town; the daily demand being 60,000 cubic feet, while only 45,000 cubic feet can be made. The total storage capacity is 78,000 cubic feet. The works are in the hands of the Local Authority, who have not increased the retorts since 1883.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

Illuminating Gas from Sewage Sludge, and the Coalowners' Combination.

Sir,—Two years since, the results of experiments made at these works in obtaining illuminating gas from sewage sludge were published in the "Journal." Since then, further experience has been gained. Some of the material has been carbonized in ordinary inclined retorts upon a manufacturing scale; a mixture of about 25 per cent. of sludge and 75 per cent. of coal being used. In the first place, a difficulty was experienced with the heats, due to the excessive moisture, as the sludge contained an average of 28 per cent. Hence with the coal mixture it equalled 7 per cent., excluding the moisture in the coal—altogether too high a figure for successful working. Some of the sludge material, after being dried and mixed with coal, did not present any difficulty in the matter of carbonization. The fundamental difficulty is the moisture. If this can be overcome, many gas engineers would doubtless be prepared to make extensive trials and use of the material. Of the practicability of utilizing sludge when dried, I am now thoroughly convinced.

The cost of labour alone, as compared with coal, shows, as might be expected, a large increase. This can be counterbalanced if an enterprising Sanitary Authority could be induced to pay to the Gas Department the amount it now costs them to dispose of the material, either by destruction or otherwise. The cost of destruction, including labour, fuel, and capital charges, is in some towns enormous. With the present exorbitant price of coal, an experiment on a large manufacturing scale, running on continuously for some time, would be most interesting and useful.

At these works, we have an oil enrichment plant which allows the illuminating power of the gas to be raised to the required standard when using the sludge; and at many works carburetted water gas, the Clark-Maxim carburettor, or some other enrichment process, is available for similar purposes. More will yet be done in the direction of carbonizing sewage sludge for the purpose of obtaining illuminating gas. A mixture of coal smudge and the compressed sewage sludge cake would carbonize splendidly; but by itself the viscosity of the material, unless absolutely dry, would prevent anything satisfactory being accomplished. There is not any objectionable odour resulting when a retort which has been charged with sludge is drawn; the material having been perfectly destroyed. The complete destruction of the material commends itself upon sanitary grounds.

If some few engineers would make experiments as opportunity occurred, important results would be forthcoming. The time involved in the necessary research work in this direction would be amply repaid. I am unaware whether anything has yet been done with patent No. 20,184, taken out in 1897 by Mr. W. Dancer, of Manchester, for "Producing gas from sewage sludge."* I was pleased to see recently a report of some tests made at Chorley, showing 4000 cubic feet of 20-candle gas as being obtained per ton from dry sludge. The excellent paper read by Mr. Duncan Cameron, the City Surveyor of Exeter, in 1898, at the meeting of the Association of Municipal and County Engineers, conveyed the valuable information "that one of the most notable points observed in the Exeter (septic) tank had been the hitherto unrecognized energy stored in the sewage, as evidenced by the production of marsh gas." He also stated that the works and public baths adjoining at Exeter had been lit with the gas; and he furnished many other items of interest.

With the numerous suggestions as to manufacturing gas from garbage and other refuse, much remains to be done; but it is only by tentative efforts that some preliminary information will be available.

If anything can be done to checkmate the designs of the coalowners and the "squeezing" operations Lord Masham recently revelled in, a step in maintaining the prosperity of the Empire will have been accomplished. The coalowners have combined to raise prices beyond all reasonable limits, and it now remains for the large coal consumers to combine to resist them. Such combination can take various forms.

Huddersfield, Oct. 26, 1900. Edward A. Harman.

LEGAL INTELLIGENCE.

Sugg and Co., Limited, v. The Somzee-Greyson Gas-Light Syndicate.

This was an action remitted from the Queen's Bench Division of the High Court of Justice for trial by the Official Referee, and it was before Mr. E. Pollock from Wednesday till Friday last week. As opened by Mr. Loehnis, who, with Mr. A. Neilson, appeared for the plaintiffs, the proceedings were taken to recover the sum of £900 for work done and materials supplied to the defendants in 1898 and 1899; or, in the alternative, to recover £1133 2s. 7d. on a *quantum meruit*. Some of the items were admitted by the defendants, who had paid £400 into Court in respect thereof. The Somzée-Greyson Syndicate was formed in 1897 to exploit an invention of Mr. Paul Greyson de Schodt for increasing the pressure at which gas could be brought to the burner for consumption. Mr. Francis Fox, who, with Sir Douglas Fox, was an Engineer of the Great Central Railway, was a member of the Syndicate, who desired to obtain a contract for lighting the Marylebone Terminus of the Railway; and from early in 1898 they were consulting with Mr. Sugg, the Managing Director of the plaintiff Company, as to the best means of perfecting the invention. The mechanism of the original compressor was altered from time to time, and eight large drawings and models were produced, showing the various stages through which it passed before reaching its final form. It was in respect of the alleged improvements to the compressor that the claim arose. An agreement was entered into between the parties, a considerable amount of correspondence ensued, and four different patents were taken out by Mr. Sugg, as to which the defendants claimed to be entitled to an interest of one-half. The defendants, for whom Mr. Cababé appeared, relied largely on a letter dated Sept. 27, 1898, of which the plaintiffs

* See "Journal," Vol. LXXII., p. 379.

had no recollection until their attention was called to it about a year later by the defendants, and of which a press copy was subsequently found. It was contended that by this letter Mr. Sugg had undertaken to supply drawings, &c., and execute all necessary work, at a maximum cost of £170, half to be borne by each party. For the plaintiffs, it was alleged that when Mr. Sugg signed the letter no amount was specified; but, by some means, the figures were placed upon it after the press copy was taken. The plaintiffs were unable to say who inserted them; but contended that it was ridiculous to suppose they meant to do work costing thousands of pounds for the sum mentioned. The defendants alleged that the plans and drawings for which they were now asked to pay had been used for other purposes, particularly in reference to the lighting of the Marylebone Station and the Crystal Palace. Evidence was given by Mr. W. Sugg, Mr. Sugg Wright, and Mr. Waller, the plaintiffs' Accountant and Advertising Manager. In the result, the matter was compromised upon the basis that the plaintiffs should have the money which had been paid into Court, that the drawings and compressors made as patterns should be handed over to the defendants, and that both parties should pay their own costs—an arrangement which the Official Referee thought was creditable to both sides.

In re the Coventry Gas-Fitting Company.

Sitting as Vacation Judge in the Chancery Division of the High Court of Justice, Mr. Justice Buckley recently had before him a motion in a debenture holder's application for the appointment of a Receiver and Manager of the above-named Company. The plaintiff was the holder of £350 of the first series of debentures, which amounted in all to £10,000; and there had also been issued second and third debentures to the amounts of £7000 and £3000. It was stated that the principal of the first debentures became due on the 30th ult., and that there was evidence that the Company were not in a position to pay them off. There was a liability of about £4000 to unsecured creditors, who were pressing for payment. As a ground for the appointment of a Manager as well as Receiver, his Lordship was informed that the Company were carrying on a considerable business, employing some fifty hands, and paying about £80 a week in wages. Debenture-holders to the amount of £3000 of the second series, and the holder of the whole of the third series were represented by Counsel, as were also the Company; but there was no opposition to the application. His Lordship appointed a gentleman named in the notice of motion as Receiver and Manager; but, in accordance with the usual practice, directed that he should not act as Manager for more than three months without the leave of the Court.

A Claim by the Bexhill Water and Gas Company.

Before the Hastings County Bench last Saturday week, Mr. Arthur Page was summoned by the Bexhill Water and Gas Company in respect of a claim for £69 12s. 5d. for gas and water supplied to the Marine Hotel. Mr. Hetherington appeared for the Company, and Mr. Grant for the defence. Mr. M. H. Sharpe, Chief Clerk to the Company, said that the Company had supplied gas to the hotel to the value of £46 4s. 10d., and together with the water the amount was brought up to £69 12s. 5d. The water and gas were furnished to Mr. Kirk, then to the Official Receiver, and witness went to the hotel after this to get an application signed by Mr. Page. The defendant said he would send it away and get it signed. Cross-examined: He believed Mr. Page and any caretaker in a place was liable. There had never been an application made by Mr. Page for gas and water. Mr. Frederick Russell, Manager of the Company, said he had received payment from the Trustee who succeeded the Official Receiver. He found out that Mr. Page was the Manager from an intimation from the Trustee. Mr. Grant contended that Mr. Kirk was liable, and under the present circumstances there was no change of occupancy, coming as it did through Mr. Kirk, the Official Receiver, the Trustee in bankruptcy, and then Mr. Page. In the event of a new tenancy, a gas and water company could not compel the tenant to pay up arrears left by a former tenant. But in the present case this could be done; and there was no contract on the part of Mr. Page with the Company. The Magistrates dismissed the case, allowing costs.

Tampering with Gas-Pipes.

At St. Helens, Henry Bridge, of College Street, has been summoned by the Corporation for laying a gas-pipe to communicate with another pipe without their consent. Mr. L. Rawlinson, Deputy Town Clerk, prosecuted; and defendant pleaded guilty. It was stated by Mr. Rawlinson that defendant was a chemical plumber as well as being the occupier of a shop. He had had a gas-meter in his cellar, but thought fit to remove it upstairs. This necessitated an extra length of piping between the meter and the iron service-pipe; and to the extra length defendant attached a branch to supply his stove in the cellar. The gas so used did not go through the meter. The Corporation did not believe that defendant meant to defraud, but asked for such a penalty as would deter others from doing a similar thing. Defendant said he put on the extra length innocently; and a fine of £1 and costs was imposed.

The Projected New Water-Works for Rugby.—For some considerable time past, the question of the water supply to Rugby has been exercising the minds of the members of the District Council; and some twelve months ago Mr. C. Hawksley was called in to make an inspection of the district and report as to the future supply. He recommended that water should be obtained from Shawell Brook, about three miles away, conveyed to Rugby, and stored in a large reservoir. He calculates that from this source the supply will be a million gallons a day; and the cost of the undertaking he estimates at £60,000. At a special meeting of the Council last Wednesday, it was unanimously decided to promote a Bill in the next session of Parliament to authorize the Council to construct additional water-works, &c. Mr. Hawksley's scheme is favoured; and a town's meeting is to be held to discuss the matter. In connection with the existing supply, Colonel C. H. Luard last Friday held an inquiry respecting an application by the Council to the Local Government Board for sanction to the borrowing of £9800 for purposes of water supply, and £320 for water-mains in new streets on the Moat Estate.

MISCELLANEOUS NEWS.

FATAL ACCIDENT AT THE SHEFFIELD GAS-WORKS.

Two Men Buried in a Coal-Shoot.

Last Wednesday afternoon, a serious accident occurred at the Grimesthorpe Gas-Works, Sheffield, resulting in the death of a man named Simpson, and serious injury to another named Claridge. Both men were employed by the Sheffield Gas Company as coal trimmers; and about four o'clock on the above-named day they were engaged in shovelling coal from one of the hoppers, when a huge mass fell from above, and buried them. Mr. Hack, the Manager of the works, and Mr. J. W. Morrison, the Company's Engineer, on learning of the accident, immediately requisitioned all the available hands—some 30 or 40—for the work of rescue; and the task of digging out the unfortunate men was commenced with all possible speed. But little progress was made. In the first place, only a limited number could enter the hopper at one time, and then almost as fast as the coal was shovelled out more fell. A medical man (Dr. Mylan) had been summoned ready to offer assistance as soon as it was required; and he was present some time before the buried men were found. As seven o'clock approached, the hand of Claridge was laid bare; shortly after that hour, the efforts of the band of workers were so far rewarded that he was dragged out unconscious. Dr. Mylan quickly applied restoratives, and soon had the satisfaction of witnessing signs of returning animation. Fortunately, Claridge had been protected in a measure by a sheet of corrugated iron which fell above him, and by some shovels and other tools, which kept the full weight of the coal from his body. He, moreover, was not so far inside the hopper as his unfortunate comrade when the fall occurred; and some air was able to filter through the cobbles to him, and so keep him alive until succour arrived. As it was, he was found to be suffering severely from shock. He had slight bruises on his face and neck, as well as on his arms and left side. Dr. Mylan, having satisfied himself that the injuries were not in themselves serious, sent the man home. After Claridge had been extricated, the men worked on in the hope of soon finding his comrade. He was, however, buried much farther down than Claridge; and it was not until eight o'clock arrived that his body was discovered. It was found to be much crushed by the pressure of the coal; but death was stated to have been due not to this cause, but to suffocation. Dr. Mylan said the unfortunate man had been dead for some time. The work of rescue was carried out by Mr. Wilkinson Heap, the foreman, under the immediate supervision of Mr. Hack. To these two gentlemen, as well as to Mr. Morrison, is due everything in the way of commendation it is possible to give to them. Had it not been for the admirable manner in which Mr. Heap marshalled the men immediately engaged upon the work of rescue, it is practically certain Claridge would also have lost his life. Though Dr. Mylan could not immediately engage in the work, he was untiring in his patience; and had it not been for his prompt services, Claridge, when extricated, might not have recovered.

The Inquest on Simpson.

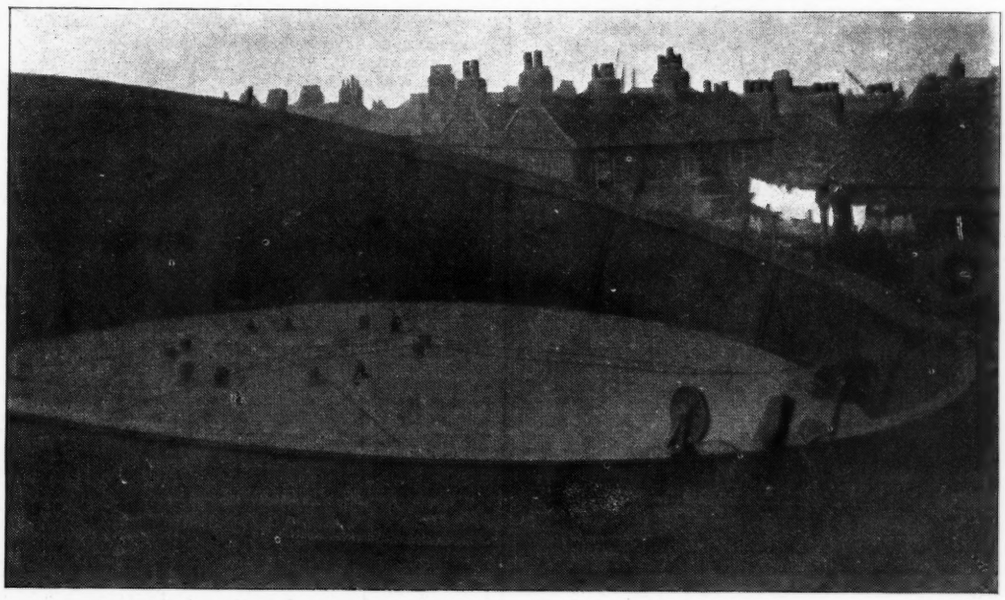
Last Friday morning, Mr. Dossey Wightman held an inquiry into the circumstances attending the death of Simpson. Among those present were Commander Hamilton Smith (one of Her Majesty's Inspectors of Factories), and Mr. W. E. Clegg, who represented the Gas Company. Evidence of identification having been given by the brother of the deceased, Mr. Morrison produced a plan of the coal-bunker in which the accident occurred, and explained that in one corner was a shoot leading to the breaking-machine, into which the coal gradually fell, and then was conveyed by elevators to the retorts. The machine had a tendency to draw the coal through the shoot; and subsequently, as long as it was working, the coal was on the move. Arnold Straw, a labourer, deposed that about ten minutes to four on the afternoon of the accident he was in No. 2 bunker—in the chamber next to where the deceased was working with a man named Claridge. He heard someone shouting and asking him to "stop the belt." He had this done, and then ran into No. 1 bunker, where he saw Claridge in the coal. Claridge called to him to lower a rope; and he dropped one, slipped it over the man's left arm, and tried to drag him out. Claridge, however, soon asked him to desist, telling him that he was "pulling his arm out." All the time this was going on, Claridge was moving down with the coal, and so was witness, as the coal was continually slipping. Witness finally had to pull himself out by the rope to save himself; and he afterwards tried to keep Claridge's mouth clear. The elevator was stopped as soon as the accident was known about. The coal was then over Claridge's head. Claridge was got out alive in about three hours, through the shoot of the elevator; but it would be four hours before Simpson was recovered, as he had to be dug out from the top. Witness went on to say, in answer to special questions put on the point, that it was a regular occurrence for the coal to "bind" at the bottom of the shoot, and the men had to do the best they could to remove the obstruction. Sometimes they started at the bottom, and at others at the top. They had heard of planks being found among the coal; but they should not be there. Witness went on to explain that some work was being done in the building over the coal, and a lot of scaffolding had been there for some time. He supposed that the planks had fallen into the coal from the scaffolding. When the planks dropped into the bunker, they should have been immediately got out. In reply to the Inspector, witness said it was the custom, when the bunker was partially empty, for men to go down and get the coal through the shoot—in fact it was part of the daily work of such men as deceased. He thought it would be an advantage to these men if there was an iron ladder from the shoot, to enable them to get out of the way in case of such a fall as the one which caused the accident. The Inspector said the idea of the ladder came from the foreman of the works. Herbert Hamilton, a foreman at the gas-works, said the block in the shoot was caused by two planks. He was not on the spot at the time of the accident; but he was present when the planks were got out, and they would be about 10 feet long. He could not state positively where they had come from; but he said they must have been in the bunker for some four or five weeks. They had most likely come from a scaffolding above the

bunker, which had been used by some contractors engaged in repairing the building. The planks were first discovered on the previous Saturday night, and a small piece of wood was then taken out. On Wednesday, the deceased and Claridge entered the bunker from above with the intention of removing the other two planks. They had got at one of them when the slip of coal occurred, and it completely buried them. A ladder put up the side of the bunker would not be of much use to the men. What was required was a side door. In answer to the Coroner, the Inspector said he thought the matter had been sufficiently explained. Mr. Clegg stated that during the whole time the shoot had been in operation there had been no trouble whatever in loosening the coal. If there had been, of course, the Company would have done everything they could to remove the difficulty. Now that they were aware there was danger, they were ready to do anything they could to minimize it. The Coroner remarked that in that case, so far as he was concerned, he would be perfectly willing to leave the matter as it stood. Mr. Clegg said that anything the Inspector suggested, the Company would be willing to carry out. The Inspector said it was a matter for consideration; but he was quite sure they would be able to discover some means of minimizing the risk. The Coroner, in summing up, advised the Jury to return a verdict of "Accidental death." He inquired after the condition of Claridge, the other victim of the accident; and Mr. Morrison said he heard the previous night that he was progressing very favourably. A verdict was then returned in accordance with the Coroner's suggestion.

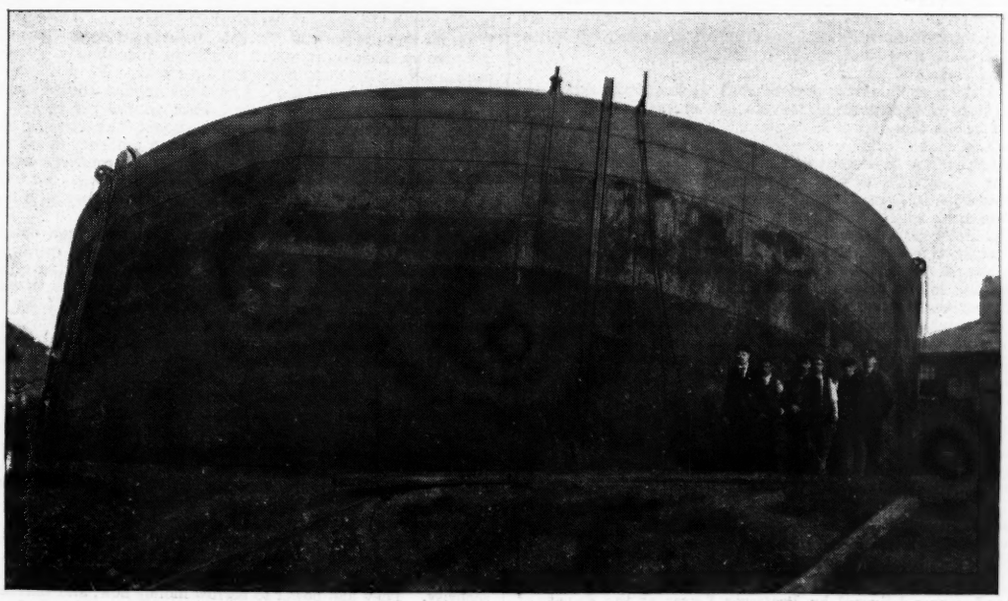
THE WRECK OF THE BARKING HOLDER.

The accident to a gasholder at the Barking Gas Works, which was chronicled in a few lines in last week's issue, is a more calamitous affair than the slender information which we then possessed led us to suppose. A visit to the works and an inspection of the crippled holder have shown the seriousness of the collapse; all the circumstances being about the worst that one can imagine surrounding such an event. The holder (which is guided on Pease's wire-rope principle) is the mainstay of the gas supply of the district—in fact, the only other holder on the works is hardly worthy of the name. It is merely of 14,000 cubic feet capacity, and previous to the accident had been out of use for a considerable period. The time of the mishap was 4.30 on Thursday, the 18th inst., just as dusk was setting in, and the consumers were about to draw on the works for their means of illumination. It is an easy matter to picture the distress and embarrassment of a Manager at that hour of the day to find his store of gas, without warning, suddenly dissipated. It is sufficient to dispirit the boldest, and to upset the best balanced head. But having seen and learnt something of the steps which Mr. W. B. Reidie, the Manager, took to minimize the inconvenience and trouble occasioned to the community of Barking by being abruptly deprived of its means of lighting, we cannot refrain from paying a tribute to the presence of mind which he displayed, and the skill with which he tackled the formidable emergency.

The wrecked holder is a two-lift one, and, as we have said, is guided on the cable principle. The dimensions of the outer lift are 62 ft. by 22 ft., and the inner one 60 ft. by 20 ft. Originally the holder was a single-lift, with columns and guide-framing; but the columns were disconnected and the framing removed at the time it was telescoped some three years ago, and then the entire structure was placed under the control of the wire-rope system. But it is only some six months since that the columns, which were perfectly useless, were taken away. The additional lift raised the storage capacity from 50,000 cubic feet to 114,000 cubic feet. At the time of the unfortunate occurrence, two of the cables were in process of being renewed. As a matter of fact, we understand that one of the new cables had actually been fitted, and it was only a question of waiting until the holder was absolutely full (for, we believe, nothing can be done to



View Showing Positions of Inner and Outer Lifts.



View Showing the Outer Lift resting upon the Edge of the Tank.

the cables unless the holder is completely charged) for the second one to be put into position. When the accident occurred, the holder was within a plate of being full; and Mr. Reidie computes that it contained about 108,000 cubic feet of gas, and that the whole of this was lost. As to the cause of the accident, Mr. Reidie very properly will not commit himself at present; and it is no use, under the circumstances, giving expression to mere conjecture. There has been an expert examination; but, until the inner lift can be inspected, the complete measure of the damage to the structure itself will not be known. Probably by this time something more has been learnt in this regard.

The photographs which we are able to reproduce through the kindness of Mr. Reidie, although a little obscure, depict the wreck with sufficient distinctness to show its completeness, and the ugliness of the task of reformation. The upper view, which was taken from the top of the small holder, shows the outer lift canted over and tightly fixed, and the inner one settled down in the tank. At one point the raised side of the outer lift is resting on the curb of the tank, as will be noticed on the left-hand side of the lower illustration, which, it is almost superfluous to say, is a view from the exterior of the elevated portion of the outer lift. The position of this lift suggests that there must have been considerable oscillation prior to the accident, although the day was calm.

This is the unenviable and perplexing position that Mr. Reidie found himself face to face with on the collapse of the holder: The loss of his entire store of gas; the diminutive gasholder of 14,000 cubic feet capacity not quite in usable condition; and the evening portion of a day's consumption of from 130,000 to 140,000 cubic feet about to be demanded of him. Fortunately, it was Thursday evening, when most of the shops in the district are closed; but still there was darkness throughout Barking from dusk until about 8 30, and great must have been the inconvenience and consternation. But in that short period, Mr. Reidie, tackling the situation with vigour, had a main laid above ground from the works to the outlet of the governor (which was the nearest convenient point until the small gasholder could be brought into use), and gas was delivered into the mains direct. In this way, the strain for the remaining hours of lighting that night was to some extent relieved. Since then, a neighbourly alliance entered into some time since between the Ilford and Barking Gas Companies has enabled the supply of gas to be maintained at very little less than its normal pressure. For the time being, the gas made at the Barking works in the daytime is sent, by the application of a higher pressure than usual, into the Ilford Company's holders, and that gas is returned to the Barking district at night time. We believe that the compact entered into was originally for the benefit of the Ilford Company (whose business, it may be remembered, has expanded extraordinarily of late years) had necessity demanded an auxiliary supply; but the arrangements then made have proved of inestimable service to the Barking Company in this time of trouble. What they would have done without the aid of their neighbours, it is difficult to conceive; and in this other companies may read a lesson. Since the night of the accident, the consumers have not been greatly inconvenienced; and they have been very tolerant, and many even sympathetic with the Company in their difficulty. No doubt a letter promptly addressed to them by the Secretary (Mr. Sturt Morris), expressing regret and explaining the circumstances, had a good effect. Immediate steps are being taken for the reinstatement of the holder; and before long we hope to hear that the damage to the structure itself is not of such a serious nature that much time will be consumed in restoring it to a usable condition. It is no use trying to minimize the gravity of the occurrence from its several points of view; but we have confidence in saying that all concerned will have the sympathy of the gas profession.

LONDON LOCAL AUTHORITIES AND THE PRICE OF GAS.

Motions to be Submitted at the Guildhall Conference.

It will doubtless be in the recollection of our readers that just before the recess the Court of Common Council of the City of London decided, on the motion of Mr. Alpheus C. Morton, to convene a conference of representatives of Local Authorities in London, to be held in the Guildhall, on the subject of "the increasing charges of the Gas Companies for the supply of gas to the Metropolis." The meeting has been fixed by the Lord Mayor for Wednesday next; and, in view thereof, the Town Clerk (Sir J. B. Monckton) has received the following notices of motions to be submitted to the delegates:—

1.—That, in the opinion of this conference, Parliament should intervene to protect gas consumers from the evil effects of the giant monopoly brought about by the Gas Acts of 1847 and 1860; and that the London Local Authorities should combine for the purpose of getting such relief from Parliament as may be deemed equitable.

2.—That, in the opinion of this conference, the Gaslight and Coke Company are not justified in charging more per 1000 cubic feet for gas supplied on the north side of the Thames than is charged by themselves and the South Metropolitan Gas Company for gas supplied on the south side; and that the Gas Companies of the Metropolis working under the sliding-scale should not be allowed to charge more per 1000 feet for gas supplied than the lowest price at which it is supplied by any one of them, so that gas consumers should not be compelled, as under the present monopoly, to make good the loss incurred by bad management.

3.—That the advantages secured to the Local Authorities on the north side of the Thames by the City of London Gas Act of 1868 and the Amalgamation Scheme of 1883, as to the supply of gas for public purposes, should not be interfered with.

4.—That the Corporation of London and the London County Council be asked to take active steps to protect the London gas consumers in the direction indicated by the resolutions passed at this conference, and to oppose the granting of further powers by Parliament to the Gas Companies unless such relief be given.

5.—That the Corporation of London be requested to send copies of these resolutions to the Board of Trade, the Local Government Board, the London County Council, and each of the new London Borough Councils.

The Cantor Lectures delivered by Professor Lewes at the Society of Arts last May, on "The Incandescent Gas-Mantle and its Uses," are now being published in the Society's "Journal."

THE CAPITAL REQUIREMENTS OF THE WELSBACH COMPANY.

Preference Stockholders Object; but the Proposals are Carried.

The Adjourned Meeting of the holders of preference stock of the Welsbach Incandescent Gas-Light Company, to consider the proposed alteration of the Articles of Association as set forth in the "JOURNAL" last week (pp. 1032-3), was held on Wednesday, at the Cannon Street Hotel. It will be remembered that the meeting of preference stockholders was adjourned owing to the fact that the attendants, with the proxies, did not represent by about £50,000 the two-thirds of the preference stock, or a million pounds, requisite to constitute a quorum. But at a subsequent extraordinary general meeting, the Chairman (Sir Henry Burdett, K.C.B.) detailed the circumstances under which it was sought to amend the Articles of Association. On the present occasion, there was a small gathering in comparison with the assembly of a week before, so that the appeal of the Directors for proxies, either for or against the proposals, had met with a response to a sufficient extent to enable the business for which the meeting was called to proceed.

It is unnecessary to recall the terms of the resolution; the principal portions having already been published. But, in moving its adoption, the Chairman referred to an apparent misapprehension as to the way in which the altered Articles of Association would affect the rights of the preference stockholders. Under the Articles as they exist, the Board had, he pointed out, the power to borrow up to one-fourth of the whole of the issued capital, or (say), in round figures, £850,000; and it was intended, under Article 54, that they should have power to borrow on security. As a matter of fact, however, in consequence of a recent legal decision, Counsel advised the Board that there was considerable difficulty and doubt as to how far the power conferred under Article 54 would warrant the Board in borrowing on security. The Directors thereupon came to the conclusion, in the interests of the Company, that their duty was to at once have the point dealt with, and that they should bring the matter before the preference stockholders. What the Board asked was not that they should make clear the authority to borrow £850,000, but simply that they should be given authority, as and when it might be necessary, to borrow £250,000 only on security. It was right that it should be understood that they were merely taking these powers for the purposes of their business, and that they had no immediate intention of putting them in force by issuing any debenture stock of any kind. The resolution altering the Articles had been carried by a very large majority at a general meeting of all the shareholders—preference, ordinary, and deferred; and in that majority was included £800,000 of preference stock holders. It was the intention of the Board to provide for the redemption of any debentures or debenture stock which they might ultimately issue.

The motion was seconded by Mr. C. L. Samson; and then ensued a protracted discussion. Mr. J. P. Hurst led off, by remarking that they had heard from the Chairman that, whether unwittingly or not, the preference shareholders made a better bargain for themselves than they thought they had, inasmuch as it appeared that, owing to some legal judgment, the Directors were unable to put anybody ahead of the preference stockholders at the present moment; and therefore it was for them to consider whether they were going to give up that most excellent bargain for nothing. They had not been offered even the proverbial "mess of pottage." The only mess they would be in would be a further fall in the value of their shares. The Directors' last report showed that the Company earned sufficient not only to pay the £75,000 required for the 5 per cent. preference shares, but after setting aside £5000 to reserve, there was still a margin over of £45,000. The Chairman told them very properly that the Board wanted to have power to get further capital, so as to enlarge the business; but he (the speaker) ventured to put this to the meeting: Supposing they did enlarge the business, supposing they earned millions per annum, of what benefit would that be to the preference shareholders? They were now making more than enough to get every penny they would derive from the Company. The Directors did not come to them and say: "This is a bargain for the benefit of the ordinary shareholders, who are at present in a very parlous condition, whose shares are hardly worth the paper they are printed on, and so it will be a very good thing for them if we can get the business enlarged. Therefore, if you will give up those rights which you have undoubtedly got, we will offer you something over and above the 5 per cent. We will have the Company reconstituted, and we will have the Articles drafted in such a way that you shall get something more than your 5 per cent." There was not a word of the kind; then why should the preference shareholders give way? In the City there had been a tendency to tamper with the rights of preference shareholders; and it was becoming a serious matter. He did not impugn the high honour of the Board. He was, however, afraid they had got proxies from many shareholders who had acted in ignorance that they were parting with their rights.

With the spirit of the foregoing speech, the Chairman entirely sympathized; but so far as he (Sir Henry) was personally concerned, he had looked to the utmost to see that the rights of every class of shareholder were protected. When the Company was incorporated, it was intended to give to the Directors, having regard to its size as a large commercial business, power to borrow money on security; and he did not think that the preference shareholders ought to avail themselves of an accident, to place themselves in a position which it was not intended they should occupy. He alluded to the rights of the other classes of shareholders; and he appealed to the preference stockholders, as business men and honourable men, to be content with the protection they already possessed. He and his colleagues were doing—and not under the most encouraging circumstances—their utmost, by all means, to make the property a richer one, and to secure the dividend firmly and continuously. He urged them not to take upon themselves the responsibility of not supporting the Board; to do so would imperil the welfare of the business, and cripple its earning power very considerably.

Remarking that the Company must do business, and that they could not do business without they had money, Mr. Samson said, in order to raise money on the best possible terms, they must be in a position to give security. They had power to borrow money now, and that money would come before the preference shareholders, just as if they had no security; but they would have to pay a higher rate of interest. A practical

view of the situation was taken by Colonel Mundy, who pointed out that Mr. Hurst's remarks appealed only (if they appealed at all) to those who were preference shareholders and nothing else. But there were a large number of preference shareholders who were also holders of ordinary and deferred shares; and to them there could be no doubt as to the advantage and necessity of raising such money as was required for carrying on the business on a proper footing. Preference shares in a company which was able to pay a good dividend on its ordinary shares were worth much more than preference shares in a company that could not do so. If the Company's factory and output were extended, and a better dividend paid on the ordinary shares, there was no doubt they would see the preference shares standing in a safer and more favourable position, and looked upon with much more favour in the market. Answering an inquiry, the Chairman stated that, if they issued any mortgage debenture stock, or debentures, the Directors would provide in the instrument for their redemption. On an inquiry by Mr. Layton, Sir Henry also replied that the Board did not intend to make any issue at present; and they hoped to prolong the time before they did do so. It was only right and customary that the preference shareholders should have the option of taking, if not the whole, the greater portion of the debentures or debenture stock.

Following this, another shareholder spoke strongly on the question of the depreciation of the Company's stock and shares in the market; and he stated that, upon inquiry, he found stockbrokers attributed this to the Company's bad management in the past, to the Company having an enormous capital and no ready money, and to the fact that the capital had been frittered away. He feared that an issue of debentures or debenture stock would further depreciate the value of the shares. He inquired whether the Chairman would give the shareholders his idea as to why the stock had dropped so disgracefully, and wound up by saying that everybody tabooed the stock except the Directors. Sympathizing with the speaker, the Chairman pointed out that he himself was in the same position as the other shareholders. But the only effect of a speech such as the one just made would be to do further injury to the property. It was only right he should say that, under Mr. Peters' management, there was no commercial enterprise in this country that was more under control or better administered than was the Company's property to-day. It was a total misapprehension to suppose that the present Directors had had three millions, one million, or even a quarter of a million of capital to fritter away. When the existing Company (which was an amalgamation of certain other Companies) was formed, the only sum which was available as working capital was £100,000; and how this had been spent he explained in his speech the previous week. The discussion proceeded to expand. One shareholder referred to the price of the mantles, and the cheaper figure at which it was stated that other mantles could be sold for; while another proprietor suggested that the expenditure might be considerably reduced. It was thought by Mr. Williamson that the resolution was of too sweeping a nature. Though it was proposed to take these powers, he understood from the Chairman that it would not be necessary to raise the debentures for a long time. Then, he suggested that they should wait until that time arrived before making the preference shareholders give away their heritage. He wished to know if he could propose an amendment, to which the Chairman replied that any amendment travelling outside the resolution would be out of order. Upon this, Mr. Williamson inquired if the resolution could be supplemented by the Directors stating the actual amount they proposed to borrow, and what terms they would offer to the preference shareholders to find the money. The Chairman's answer was that they could not supplement the resolution. Then followed further explanations of a similar character to those already given.

On the resolution being put, 48 voted for it, and 24 against; and consequently it was not carried. A poll was demanded; and this resulted in 212,943 votes for the resolution, and 4445 votes against. The amount of stock represented for the resolution was £1,064,832, against £22,726. Thus the resolution was carried by a considerable majority.

OIL GAS ENRICHMENT COMPANY, LIMITED.

The Seventh Annual General Meeting of this Company was held on Monday last week—Mr. James Milne, of Messrs. James Milne and Son, Limited, of Edinburgh, in the chair.

The Secretary (Mr. J. Gordon Mason) having read the notice convening the meeting, the report and accounts, already noticed in the "Journal," were taken as read.

The Chairman, in moving their adoption, stated that the Paisley plant had been completed, and they hoped to have the whole account in connection with it closed in the course of the next few weeks. He mentioned at the previous meeting that the Directors had made arrangements to take up another patent—viz., that of Messrs. Young and Glover for the working of the naphthalene process. They had now done so, and had begun to advertise the process, and had had several inquiries from different places in England in regard to it. With a view to helping them in this matter, the Directors had, subject to the approval of the shareholders, asked Mr. Glover to join the Board; and he had agreed to do so. The past year had not been favourable for oil gas enrichment, solely on account of the immensely increased price of the oil, which made it unprofitable for gas-works managers to use it in the way they did. However, enough had been earned to pay the dividend, and to carry forward a larger balance than on former occasions. The investments of the Company remained in the accounts at cost, as before. The decrease in value had not been great, and the Directors had no doubt they would recover and get above par again.

Mr. Hugh Brown seconded the motion, and it was carried.

The Newbury Town Council having applied to the Local Government Board for a loan of £2500 in connection with their gas undertaking, the Board have replied that they are not prepared to consider so much of the application as related to the provision of stoves. The Council have, therefore, on the recommendation of the Gas Committee, decided to place to a suspense account the expenditure on these appliances.

THE LAUNCESTON TOWN COUNCIL AND THE GAS COMPANY.

Several references to the differences which have arisen between the Launceston Gas Company and the Town Council were made at a meeting of the burgesses held last week for the purpose of nominating candidates for the Council. This was, in fact, almost the only subject discussed. Mr. T. P. Trood, a member of the Council who was proposed for re-election, expressed the opinion that the town was paying too much for the gas for public lighting. There were 120 lamps, and the average price paid was £2 16s. 1d. Twelve years ago a meter was placed on one of the lamps, and it was found that the consumption was about 10,000 cubic feet per annum. As to the roads, they were vested in the Council, and no one had a right to break them without permission. Mr. T. H. Nicholls, another retiring member of the Council seeking re-election, said he was a Director of the Gas Company, but he should not object to see the electric light introduced. As to the charge for the street-lamps, if Mr. Trood was correct in his estimate that the consumption was 10,000 cubic feet, they were not paying too much. The price of gas was 4s. per 1000 cubic feet, so that with a consumption of 10,000 cubic feet, and adding 10 per cent. for leakage, they had £2 4s. for the gas alone. Then there was the cost of lighting and extinguishing the lamps, repairs, &c. In answer to questions, Mr. Nicholls said that their Articles of Association entitled the Company to pay dividends not exceeding 8 per cent. There were seven members of the Town Council who had an interest in the Company, and who therefore did not take part in the discussion or voting on the subject of the gas supply. Mr. W. L. Powell, who was proposed as a candidate, said that as the Council was now constituted one-half of the members had to leave or remain silent when gas questions came under discussion. The Company ought to have been generous to the public as well as just to themselves. Mr. J. Treleaven, jun., said the Company had not taken full dividends by £1000. As to the suggestion that they should be generous, if they lowered the price for public lighting it would simply mean that private consumers would have to pay more. Those who were attacking the Company could not show that a higher price was being paid than in other similar towns; for, as a matter of fact, the price was lower than it was in almost every other town of the same size.

SALES OF SHARES AND STOCK.

At the Mart, Tokenhouse Yard, last Tuesday, Mr. Alfred Richards offered for sale new issues of gas and water stocks and shares. The first lots consisted of some new ordinary £10 shares in the Westgate and Birchington Gas Company, ranking for a maximum dividend of 7 per cent., the last paid having been at the rate of £5 12s. per cent. for the half year ending Dec. 31, 1899. They fetched from £10 to £10 15s. per share; and produced £3150. Some new ordinary stock of the New Swindon Gas Company (last dividend 5 per cent.) was next offered, and was sold at the rate of £110, £111, and £117 per cent.; the total amount realized being £1142 18s. A parcel of £10 "C" shares in the Harrow and Stanmore Gas Company (the last dividend on similar shares having been at the rate of £5 12s. per cent. per annum) was sold at prices ranging from £10 5s. to £10 15s. per share; producing £2620. Some new ordinary stock of the Southend Gas Company, carrying dividend from the 1st of December next, was then offered. The last dividend on the Company's existing ordinary capital was at the rate of 5½ per cent. per annum. The new issue was sold at from £105 10s. to £107 per cent.; the total amount produced being £5328. The last lots consisted of some "E" ordinary £10 shares (7 per cent.) and some 5 per cent. preference shares of the same nominal value in the Aldershot Gas and Water Company. The former fetched £15 10s., and the latter £12 each; the amounts produced being respectively £1240 and £3000. Among other sales of shares, the following may be noted: Some £10 shares in the St. Neots Gas Company were sold by Messrs. Maddison and Son at £21 15s. and £22 apiece. Messrs. Waters and Rawlence recently sold some £12 10s. shares (10 per cent.) in the Salisbury Gas Company at prices ranging from £25 to £25 7s. 6d. each; and £200 of perpetual 4 per cent. debenture stock at £112 per cent. On the same occasion, 15 fully-paid £10 shares in the Fisherton Anger and Bemerton Water Company fetched £19 7s. 6d. apiece. Messrs. Richardson and Pearce Brown, of Selby, lately sold some £5 shares in the York Gas Company at £12 15s. each. Messrs. Lancaster and Sons, at Barnsley, last Wednesday, realized the following prices for Barnsley gas stock and shares: For £128 19s. general capital stock, £190; six "D" shares and four "E" shares, paying 7 per cent., £14 5s.; four "F" shares of £10, paying 10 per cent., £15; four "C" preference shares of £10 each, paying 6 per cent., £13 10s.; and four "G" shares, paying 12 per cent., £14. At Wolverhampton, the same day, Mr. H. J. Lloyd offered for sale, in lots of £100 each, £15,000 new ordinary stock of the Wolverhampton Gas Company. On this particular stock, the standard dividend authorized by the Wolverhampton Gas Act, 1900, is 6 per cent., subject to the usual sliding-scale clauses. The bidding was fairly brisk; and the prices varied between £125 and £132 2s. 6d. Eight hundred additional ordinary £10 shares in the Frimley and Farnborough District Water Company have been sold by auction at from £13 2s. 6d. to £13 10s. each.

York Streets in Darkness.—The column of the "Northern Notes and Notions" in the "Yorkshire Herald" for last Wednesday, was headed with the following paragraph, which we will leave to speak for itself: "The principal thoroughfares in York were in darkness for the greater part of last night. . . . Pedestrians could not help stumbling against each other, and it would have been the easiest thing in the world, if any of the Hooligan element had been about, to assault and rob a person without much fear of identification. It would be well to know who is responsible for such a state of things. When the illumination of the main streets by electricity was undertaken, instructions were given by the Corporation, we believe, to cease lighting the gas-lamps, as that would have entailed unnecessary expense; but, surely, on a dark night, some steps ought to have been taken to prevent such a painful and perilous gloom."

ELECTRIC LIGHTING NOTES.

The Southampton Borough Council have approved a proposal of the Electricity Committee to apply for sanction to borrow an additional £12,000 for extensions.

The Electrical Engineer to the Hull Corporation (Mr. A. S. Barnard) has reported to the Electric Light Committee on the recent breakdown which resulted in the extinction of the light in parts of the district served, as already recorded in the "JOURNAL." The fault was located in a junction-box, where a joint in one of the large feeders had given way.

At the conclusion of last Thursday's meeting of the Rochdale Town Council, the members walked in procession to their electrical works in Gashouse Lane, for the purpose of formally opening them. It was remarked by the Mayor that it could not be alleged that the Corporation had been "too previous" in introducing the electric light into Rochdale; but he hoped that, while they had been waiting, they had learned something from the experience of other corporations. He presented to Alderman W. J. Petrie, the Chairman of the Gas Committee, a golden key with which to perform the ceremony. Alderman Petrie unlocked the door, and the Council inspected the works.

A Local Government Board inquiry was recently held at Dartford into the application of the District Council for sanction to a loan of £20,000 for the purposes of electric lighting. There was considerable opposition from some of the ratepayers; and the patience of the Inspector (Mr. H. P. Boulnois) was sorely tried at times by the interruptions. Lieut.-Col. C. N. Kidd, the Chairman of the Council, explained that there was no alternative but to go forward with the scheme or allow it to be at once taken up by private enterprise. The objectors confined themselves to declarations that the undertaking would not pay; and, when the Inspector said he should close the inquiry unless arguments could be brought forward, there was a hostile demonstration.

If, after the inquiry held by Mr. M. K. North on behalf of the Local Government Board at Sleaford last Tuesday, the electric lighting scheme of the District Council goes through, then our faith will be shaken in the usefulness of such investigations. The amount required for the scheme is £7000; and for this sum, Mr. Bremner Smith and Mr. W. H. Scott (Electrical Engineers of whom we have never heard before) declared that the installation could be satisfactorily carried out on the two-wire system. On the other hand, for the opposition, Mr. A. O. Gibbings and Mr. Vesey Brown (both well-known experts) held that the two-wire system was unsatisfactory, and that the lowest possible cost would be £10,759. Then came a petition signed by two-thirds of the ratepayers; and Messrs. Bass and Co., who are large ratepayers, entered a strong opposition.

Instances are constantly occurring of the danger arising from stray currents of electricity. A rather remarkable case in point happened at Bradford on the 20th inst., in the house of Dr. Baldwin. The family were having tea in the dining-room, when the gaslight suddenly went out. On investigation being made, it was discovered that one of the bedrooms was full of smoke, and that the floor was on fire. The fire, which was of a smouldering nature, was promptly put out; and examination revealed the fact that the water-pipe, which is in close proximity to the cable supplying current for the tramcars, had burst. The conclusion come to was that the electricity was conveyed along the water-pipe, and thence to the gas-pipe—only about an inch separating the two. The sparks generated in this way, it was thought, ignited the floor of the room. The opinion that electricity from the cable caused the fire was strengthened by the fact that for some hours the tramcar traffic was delayed owing, it was presumed, to an insufficient supply of the motive power.

The annual report of Mr. A. A. Voysey, Electrical Engineer and Inspector to the Corporation of London, sets forth that last year the total number of arc lamps lighted was 507. During the year 562 lamp failures were reported by the police, and 356 by the Inspector. The sum of the figures representing for each lamp the period during which it was not alight was 167,067 minutes. The penalties inflicted on the Company for failures amounted to £173 6s. 3d. The Corporation was still without the means of testing the value of the supply given to the public lamps. The Board of Trade had not formally approved of any type of instrument for the purpose; but one of the conditions on which the City of London Electric Lighting Company were allowed to change the standard pressure from 100 to 200 volts was that they established concurrently with the change, and under the direction of the Board, a means of testing the value of the supply to the public lamps. Only eleven meters were submitted to the Inspector last year. Nine were sufficiently correct; but the others were incorrect. The Aron meter was approved by the Board of Trade for use on alternating current circuits, and the Inspector made a number of tests with a view to determine the kind of examination that would be necessary before certifying such meters in accordance with the provisions of the Electric Lighting Orders. Negotiations had been concluded between the Corporation and the Companies for the testing of all meters at the Guildhall without expense to the Corporation. The Companies had agreed to refund to the Corporation the whole of the money expended in carrying out the work, including the salary of the Inspector. The question of the lighting of the side streets had been delayed for several years, in the endeavour to obtain a legal settlement of differences with the City of London Electric Lighting Company as to the meaning of the public lighting agreements. The delay was much to be regretted, because it was undoubtedly possible, by the use of electric lamps, to make a great improvement in the lighting of the side streets without in any way increasing the present cost of lighting by gas. The Inspector was advised during 1899 of two important interruptions in the supply of electricity to private consumers—one affecting the whole and the other only a portion of the City. Defects in the pressure of the supply occurred on eleven different occasions. At present, the Inspector had no adequate means of ascertaining how far the Company complied with their obligations in respect of the maintenance of a proper pressure of supply to private consumers. The Company, however, had been put under the obligation to provide such means as the Board of Trade should direct.

The Liverpool City Council have adopted a recommendation of the Water Committee accepting a tender of Messrs. Holme and King to construct a new reservoir at Prescot for the sum of £98,425 18s.

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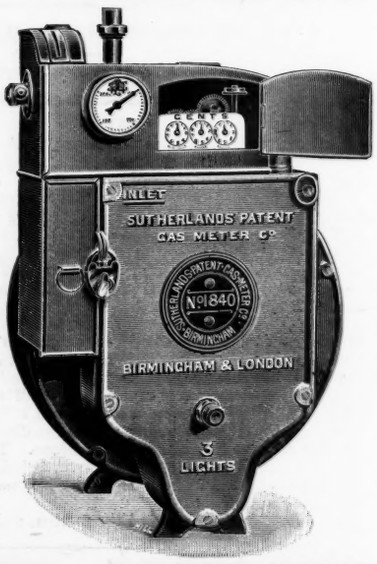

THE SUTHERLAND GAS-METER COMPANY
ESSEX WORKS, BIRMINGHAM.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

At their meeting on Monday, the principal business before the Edinburgh and Leith Gas Commissioners was the letting of the contract for the construction of the carbonizing plant upon the inclined-retort system, in the new works at Granton. The tender recommended by the Works Committee, and adopted by the Commissioners without comment, was that of Messrs. Graham, Morton, and Co., Limited, of Leeds; and the price was £113,802 17s. 9d. The contract is a very fine one. Work upon it can be started at once, as the erection of the retort-house is well advanced. The Works Committee also recommended acceptance of tenders by the representatives in Glasgow of Alsen's Portland Cement Works for the supply of 900 tons of Hamburg cement, and 100 tons of Alborg (Danish) cement. The question was raised as to why it was necessary to go abroad for cement; and the interesting information was elicited, in reply, that the cement which had been accepted was 6s. per ton cheaper than that which the Commissioners had been using, and 3s. 9d. per ton cheaper than the other samples tendered. The offers were accepted. The report by Mr. W. R. Herring, the Engineer, for the month of September, showed that the output of gas increased by 2,036,000 cubic feet during the month, and that since May 16 the increase has been 7,205,000 cubic feet. The figures are not very encouraging. A pleasing incident of the meeting was the reappearance of Mr. Kinloch Anderson, who has been so long at the head of the Works Committee of the Commission, and who has been laid aside by illness since about the end of May. He was warmly congratulated on his recovery.

It was thought that the employees of the Edinburgh and Leith Gas Commission were content with their position; and so, I believe, they are, if let alone. But the National Union of Gas Workers and General Labourers of Great Britain and Ireland have other views upon the matter. According to them no workman ought to be content unless he shapes his course according to the cast-iron regulations of the Union. A Mr. W. Blackwood, who calls himself the District Secretary of the Union, has forwarded a petition to the Works Committee of the Commission, through Mr. Herring, the Engineer, in which the following "concessions to be conceded to your workers who are members of our Union" are asked: (1) That double time for Sunday labour be granted from 12 o'clock on Saturday night till 12 o'clock on Sunday night; (2) that time-and-half for all overtime and extra work be given; (3) that, so far as possible, all unnecessary extra work and Sunday labour be abolished; (4) that whole time be given for New Year's Day, spring, and autumn holidays; and (5) "a deputation of the workmen, together with myself, will be pleased to wait upon you to explain reasons why the above should be granted." The really important condition is in the end. What is sought is not so much to benefit the men as recognition of the Union. It is evident that Mr. Blackwood is not one of the workmen; and the Commissioners should have no difficulty in telling him that they can have no negotiations with him upon the subject of their relations to their workmen.

We hear so much now of extensions of electric lighting, that it gives a sense of refreshment to the mind to learn that the Town Council of Edinburgh are being recommended by their Lighting Committee to add about 200 gas-lamps to those already in use in the city. Nearly the whole of the new lamps are required on account of the extension of the city boundaries. Of electric arc lamps in the streets there are now 846, the charge for each of which is £13 a year.

The din of electioneering work in the burghs is still in our ears, and is louder than ever. The greatest noise continues to be made in Dundee, where the observations are so voluminous that only a small percentage of them can be taken notice of. But, apart from their bulk, there are remarks being made which would be better left unsaid. These are by municipal candidates. Besides what has been spoken from platforms, there have been two special articles in the "Dundee Courier" in both of which the method of keeping the accounts of the Commission was attacked with vigour. I must say that, so far as picking holes in the accounts is concerned, the writer makes a good case. But there are few accounts which could not be similarly dealt with; and the question remains whether any good is to be done by attempting to bring discredit upon a Corporation Department. If good is to be done, the end will have justified the means; but if no good is to be done, a great responsibility rests upon those who have stirred the matter up. At the municipal meetings, the following have been the most noteworthy expressions: Treasurer Ritchie said that, under the guidance of Mr. Foulis, it was reported in 1897 that the gas-works were not in an efficient state; and they were now laying down a system for making gas which would be second to none. They were well aware that coal gas in itself must be the foundation of whatever they were to have. They could not enrich anything else but coal gas; and, according to the best experts, it was a mere waste of money to enrich. In Dundee, they had insisted on having a certain illuminating power, which could only be obtained by enrichment, as the ordinary coal would not give it. Glasgow in its inception was wise. They brought down their capital, and kept up the price of gas. Dundee kept down the price and wrote up the capital. During the years 1890 to 1895, they laid aside for the sinking fund a sum of £17,850. During the same period Glasgow laid aside £292,220. Glasgow was practically six times larger than Dundee, whose income from gas and products was £100,000, compared with £600,000 for the western city. If they had been laying aside this £5000 extra, with accumulated interest, the price of the gas-works that day would have been £120,000 less than was the case; and they knew what this meant in sinking fund. Glasgow was paying for annuities and sinking fund in 1874-5 £62,556. They had trebled their works since, and their interest and sinking fund, with all the accumulated expense, still stood at £63,000. This was what Glasgow did; while they in Dundee were doing the other thing. In Dundee, interest on capital was 9d.; in Glasgow, it was 2¾d. As to the question of rebate, according to Sir Thomas Thornton—and they preferred to take their law from the man they paid for it—they could only charge after April 30 at the higher rate. About 270 people had claims. The sums ranged from 1d. to 10s.; and all that had been paid up to Saturday was £70. The only person, however, to whom injustice was done was to anyone who removed or ceased to use gas. To those who remained in the house, a

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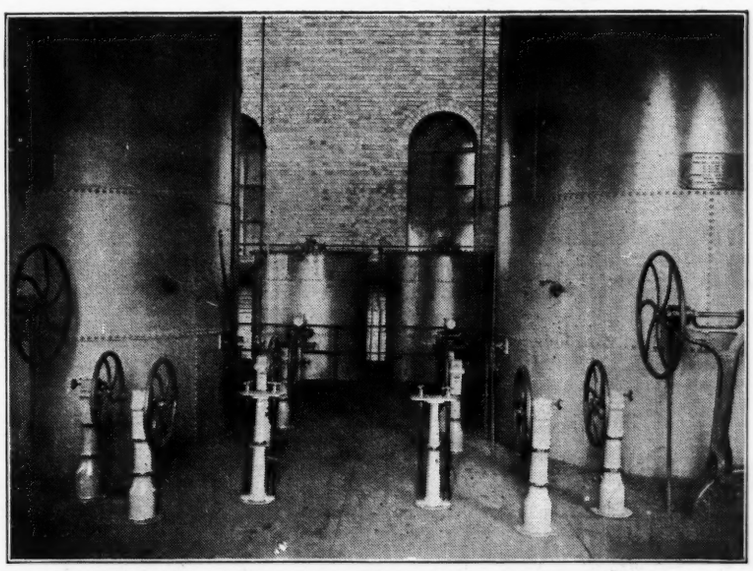

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full year's gas was given at the same price; and let them remember they had had five reductions to one advance. Bailie Robertson said that, as soon as the gas-works were reconstructed, he should be prepared to move that a Committee be appointed to sit along with Mr. Foulis, who was superintending the reconstruction of the works, to look into the entire organization and management of the works. He was informed that the proportion of foremen to the number of hands employed at the works was too large at the present time; and there were a great many people there who had not very much to do.

In an editorial in the "Dundee Courier" it is pointed out that in the estimates for the year now current the anticipated cost of coal is stated at £61,154, and that, as the sale of gas is put down at 583 million cubic feet, the cost of coal will be 25·17d. per 1000 cubic feet; whereas in Broughty Ferry the cost of coal is set down at £2289, and the sale of gas at 50 million cubic feet—making the cost of coal 10·84d. per 1000 cubic feet, or 14·33d. less than in Dundee. The price of gas to the public in Dundee is 1s. 2½d. per 1000 cubic feet more than in Broughty Ferry.

Greenock gas affairs have not been in a satisfactory state for some months. This is abundantly shown by the speeches delivered in the various wards of the town in view of the forthcoming municipal election, and also by the answers given by the councillors in the course of their "heckling." Mr. D. M'Callum in the Second Ward, on Thursday night, stated, when touching on the Gas Trust, that the deficiency of £2600 was due chiefly to the high price of coal, and the great difficulty in getting supplies. There were still one or two contractors who had not yet delivered all the coals which they contracted to do, and a Special Committee was appointed to look into the matter. The audience might rest assured that the contractors would be compelled to implement their bargains or pay the differences. At the meeting of the Fifth Ward on the same evening, Bailie Cameron also referred to the affairs of the Gas Trust, touching upon the subject of the unfulfilled coal contracts. He remarked that at a meeting of the Sub-Committee it had been resolved to claim from the contractors the difference between the contract value and the price of coal at the date of the breach of contract, and he hoped that they would be able to make an arrangement which would be satisfactory both to the Corporation and to the contractors. Replying to a question at the "heckling" time, he said that it was the opinion of the Legal Adviser to the Board that it was quite legal to make the price of gas retrospective from last May, and his two colleagues, Mr. Andrew and Dean Chalmers, quite approved of the Gas Trust doing so. The Seventh Ward meeting was also held on Thursday night, and the principal speaker at it—Bailie Campbell—the Vice-Convener of the Gas Trust, dwelt at considerable length on the affairs of the Gas Department. For some months past, he said, much which could only be characterized as crude, ill-informed, and misinformed criticism had been passed on the department; and what had really been for the most part the inevitable result of absolutely abnormal conditions in the various quarters from which their materials for production were drawn had been construed into charges of incompetence and mismanagement of the grossest and most culpable character. When, however, they came to investigate the facts, they found the matter to be simplicity itself. After making sundry explanations, he went on to refer to a number of questions dealing with the Gas Department. Some of the questions were as follows: Has there been a deficiency in the Gas Trust through irregularities? When did the irregularities begin? Has the amount been recovered, and what steps were being taken to recover the deficit? If the deficit was unpaid at the time the balance was made, how is it shown in the Yellow Book? He replied at length to these queries; saying that sums amounting to something over £600 had been collected by the late Gas Manager, and had not been handed over to the Town Chamberlain. The most careful and painstaking investigations had been made and failed to yield an explanation. They had never heard, and they could never hear, what the late collector might have said on the subject. But the late collector's representatives considered the matter carefully, and they intimated through their law agent that they were prepared to indemnify the Police Board the full amount in question. Some prominent citizens were at the meeting, and spoke very guardedly on the subject of the delinquencies of the late collector, and subsequent Gas Manager.

At Falkirk, one of the retiring representatives this year is Bailie Cook Rennie, the Convener of the Works Committee of the Gas Commission. He is being opposed by Mr. Stevenson, an ex-Treasurer of the burgh, whose platform is that during the seven years he was in the Town Council there was a reduction of 6½d. per pound upon the rates; but that since he left the Council, the rates have increased by 7½d. per pound. One of the items which he selects wherewith to connect Bailie Cook Rennie with not having a due regard for economy, is that he was the chief agent in the promotion of the Act of last session, which gives the Gas Commissioners power to acquire land at Thornhill, and to erect a new gas-works there. Mr. Stevenson asks if they have not already a site for a new gas-works at Parkhouse, for which they paid £6000, and upon which they have erected a gasholder costing about £8000. Now, the Parkhouse site, according to my recollection, was considered, and was declared to be unsuitable, on account of its being damp; and it is also said that it is not large enough. Mr. Stevenson does not controvert these statements, but simply says they were not proved. Bailie Cook Rennie informed the electors this week that the site at Thornhill had been secured, and that the erection of the new gas-works would be proceeded with so soon as negotiations relating to the railway accesses were completed. So that Mr. Stevenson is too late with his opposition to the transfer of the gas-works. It is to be hoped that he will not succeed in ousting Bailie Cook Rennie, who, whatever his merits may be, has begun a great work for the Gas Commissioners of Falkirk, and should be allowed to finish it.

In Hamilton, no gas subject can be found upon which to fight, because Mr. Ewing's appointment at Greenock has taken away the only bone of contention which has existed—his having rendered better service to the community than his predecessors did. One speaker said that they had been getting cheap management, because in gas-works where the output was less than one-half what it was in Hamilton the managers were paid larger salaries. If this be so, the reproach should be removed now. Bailie MacHale, the Convener of the Works Committee, expressed regret that they were about to lose the services of Mr. Ewing. He anticipated that they would have a profit of £1200 a year from their sulphate of

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ammonia plant; and he thought it was worth consideration whether the profit from sulphate should not be applied to some special purpose. He threw out the suggestion, so that posterity might ear-mark this profit, and devote it to the erection of a town hall and municipal buildings. Treasurer Keith heartily concurred in the suggestion that the profits on the sulphate department should not be devoted to making gas cheaper than anywhere else in Scotland, but should be applied to some purpose of public utility. It is a very specious plea that they are to take the profits upon sulphate only for public purposes, and to leave gas production to stand or fall by itself. But there is no defence for the one proposal, any more than there would be for the other; and it will be better for the community if the Corporation go no further than they have done in the matter of appropriating profits upon municipal trading for the relief of the statutory rates. The principle is not a healthy one.

At a meeting of ratepayers in Johnstone on Thursday night, Provost Lang said that the Corporation were expending upwards of £10,000 on the gas-works, to fully equip them to supply the enormously increased demand for gas. The extensions were not limited to the present pressing demands, but would meet the requirements of the burgh for a good many years to come. He pointed out that the total make of gas seven years ago in Johnstone was 26 millions; whereas, with the progress of the town and district, the make had risen to over 42 millions per annum, which he considered most satisfactory. No increase had taken place in the price; and he thought this was a matter for congratulation, as most burghs in Scotland had had to raise the price of gas from 5d. to 10d. per 1000 cubic feet.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Oct.* 27.

Sulphate of Ammonia.—In the early part of the week, the market was very firm; and a fair business was done at full prices. Later, however, demand slackened; consumers declining to follow the upward movement, and buying being mainly in second hands. The closing quotations are £10 15s. to £10 16s. 3d. per ton f.o.b. Hull and Leith, and £10 17s. 6d. to £11 f.o b. Liverpool. Makers are firm at these prices; but re-sales are being made at less money. There is considerable inquiry in the forward position; but the firmness of makers precludes much business, while speculators seem nervous about offering ahead. London, Beckton terms, January-March, is quoted £11 5s. per ton; and this is required f.o.b. Leith and Liverpool, ordinary terms, for November-March.

Nitrate of Soda is very firm at 8s. 3d. to 8s. 6d. per cwt., according to quality, on spot.

LONDON, *Oct.* 27.

Tar Products.—Excepting benzol, this market generally continues sluggish and uninteresting. For benzol, the demand seems to be better; but there is great irregularity in the prices quoted, presumably arising from the difference in the cost of putting it f.o.b. or otherwise. There is as much as 2d. a gallon difference in quotations in the various districts. 90's continue to be in more favour than 50's. For toluol, however, a better business is in prospect; and this should influence 50's materially. Solvent naphtha continues dull, with only small inquiry. Carbolic acid is quoted lower; and the article appears to be in the hands of operators who are moving for a fall. The production of carbolic is now much larger than it has been for some months. Makers have been hoping that higher prices would be possible; and only a few of them are committed to contracts. It is possible the fall in values may be speedily arrested, as the corner is too apparent. There is no change in anthracene or pitch.

Quoted values during the week average: Tar, 15s. to 21s. Pitch, east coast, 35s. 6d.; west coast, 32s. 6d. Benzol, 90's, 9d. to 11d.; 50's, 1s. Toluol, 1s. 3d. Solvent naphtha, 1s. 2d. Crude naphtha, 5d. Heavy naphtha, 1s. 0½d. Creosote, 1½d. to 2d. Heavy oils, 2½d. to 3½d. Carbolic acid, 60's, nominal, 2s. 7½d. Naphthalene, 80s.; salts, 60s. Anthracene, nominal "A," 3¾d.; "B," 2¼d.

Sulphate of Ammonia.—The better outlook for this article has not been maintained; and to-day it is quoted lower in all positions. After touching an average of £10 16s. 3d. per ton, it is now again quoted generally at £10 12s. 6d. to £10 15s., less 3½ per cent., according to position.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The talk which has been prevalent in some quarters recently of a possible further advance in prices with the close of the present month, has completely subsided; and at a meeting of the West Lancashire Coal Sales Association held last week, no proposition was even made that prices should be altered. The question was unanimously adjourned till towards the close of November; the representatives present evidently being content to allow both inland and shipping list rates to remain for the present on their existing basis, although, in the case of shipping orders, this represents 1s. to 1s. 6d. per ton under what is just now actually being obtained on current sales. The better qualities of round coal have been in rather more active request during the past week; no doubt owing to the winterlike weather, and pits remain in the position that they are accumulating very little in the way of stocks for winter requirements. Common round coals, although in less pressing inland demand, especially for iron-making purposes, are still moving away pretty freely for shipment; and there is no surplus of any moment hanging at collieries. Prices at the pit mouth remain firm at 16s. 6d. to 17s. 6d. per ton for best Wigan Arley, 15s. to 15s. 6d. for Pemberton four-feet and seconds Arley, 14s. to 14s. 6d. for common house coal, and 12s. 6d. to 13s. for steam and forge coal; while for shipment, although the official minimum basis is 15s. 3d. per ton, 16s. to 16s. 6d. is being obtained for the ordinary sorts, up to 16s. 9d. and 17s. for the very best qualities of steam coal, delivered at the ports on the Mersey. The position with regard to engine fuel is not quite so satisfactory as in round coals. Though at a meeting of the West Lancashire Coal Sales Association a formal resolution was passed confirming the minimum basis of 10s. 6d. for slack, list prices are not being maintained outside the Association; and even some associated members are reported

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to have been underselling recently in the open market. At any rate, the question has been adjourned for further consideration. In the meantime, surplus slack is coming in from other districts at much under the official quotations of the Lancashire collieries. Common qualities of Lancashire slack can be bought at from about 9s. to 9s. 6d. per ton, with best sorts quoted from 10s. 6d. to 11s. per ton at the pit. The inferior qualities of coke for furnace purposes continue weak, with lower prices quoted, not so much by Lancashire makers as in the Yorkshire district; and from 15s. to 20s. at the ovens, according to quality, represent about the figures at which contracts could now be placed. Foundry cokes continue in fairly good demand, and are generally maintaining late rates; averaging about 28s. to 30s. per ton at the ovens.

Northern Coal Trade.—The coal trade of the North shows continued quietness, more especially in the steam coal trade. Best Northumbrian steam coals are rather weaker in demand, and lower in price; the effect of the loss of the Baltic trade being more greatly felt. The price of this class of coals is about 17s. to 17s. 3d. per ton, f.o.b., second qualities are 16s. 6d., and steam smalls are 9s. 6d. to 10s. In the gas coal trade, the demand increases as the nights lengthen, so that a large portion of the production is taken up in the supply of the large contracts that are running. For occasional cargoes, the quoted price is about 17s. per ton. This is lower than a month ago, but is still 1s. per ton above the rate at which the chief contracts are now being delivered, and still more above those which have been settled for long periods ahead at from 13s. 6d. to 13s. 9d. per ton f.o.b. The coke trade is steady, except for the export kinds; the closing of the Baltic having minimized the demand for the latter. For export, 25s. to 29s. per ton is the f.o.b. price; while for blast-furnace kinds about 26s. is the medium quotation. Gas coke is quoted at from 24s. to 25s. per ton, f.o.b.; but there are some contracts running at lower figures.

Scotch Coal Trade.—It is now admitted that a time of difficulty is ahead in the coal trade. Exports are declining; the home demand is largely due to a desire to stock coal, which the miners object to; and, according to the wording of the agreement which has been come to, the miners' wages are to rise higher still. When the inevitable rush of workmen to the pits takes place, these wages will not be maintainable; and then trouble with the Unions may be looked for. Over and above all, if rings or corners be formed among those who have coal to sell, the market will be an exceedingly ticklish one to operate in for some months to come. The prices quoted are: Main, 15s. to 15s. 3d. per ton, Glasgow, f.o.b., ell 15s. 6d. to 16s. 6d., and splint 16s. 6d. to 17s. The shipments for the week amounted to 227,519 tons—a decrease of 13,048 tons upon the previous week, but an increase of 46,587 tons upon the corresponding week of last year. For the year to date, the total shipments have been 9,135,478 tons—an increase of 1,967,451 tons over the same period of last year.

The Proposed New Gas-Works for Coventry.—At to-day's meeting of the Coventry City Council, a report will be presented from the Gas Committee, recommending the erection of auxiliary gas-works, at an estimated cost of £130,000.

Proposed Purchase of the Devonport Gas-Works by the Corporation.—Notice has been given by the Devonport Gas Company of their intention to promote a Bill in the ensuing session for the increase of the capital and other purposes; and last Thursday, a private meeting of the Town Council was held to consider the matter. The Corporation recently consulted Mr. C. R. Bellamy, of Liverpool, as to the improvement of the street lighting; and they have since asked his advice on the subject of the purchase of the undertaking. It is stated that Mr. Bellamy has strongly advised the Council to promote a Bill for the purchase of the works: A resolution in favour of this course was adopted after considerable discussion. The Company was formed in 1853, and the capital consists of 7000 original and 300 guaranteed shares, each of £5, and of £15,000 in debenture bonds—a total of £65,000. The income last year amounted to £39,312.

Honiton Water Supply.—The question of the water supply was further considered by the Honiton Town Council at a special meeting held last Wednesday. It was decided to proceed with the scheme proposed by Messrs. Beesley, Son, and Nichols, of Westminster, and to make application to the Local Government Board for permission to borrow the money. In the course of the discussion, Mr. F. A. Buckingham accused the majority of the Council of attempting to rush the scheme through; and he proposed that its consideration be deferred until after the municipal elections on the 1st prox. Mr. G. Gidley, who seconded this, alleged that the water with which the town is supplied from St. Cyres is not pure, and that to impound it in a reservoir would make its condition worse. The Mayor (Mr. R. H. Matthews) said the reports of the Medical Officer of Health showed that the water was pure; and Mr. E. W. Matthews added that two thirds of the competing engineers totally or in part favoured the present source of supply.

Gas at the Brewers' Exhibition.—There was little of special interest to readers of the "JOURNAL" at the Brewers' Exhibition, held at the Agricultural Hall, Islington, last week. Incandescent gas lighting was in use at several of the stalls; but the brilliant display made for several years in succession by the Incandescent Gas-Light Company at the end of the arcade leading to the hall from the principal entrance was conspicuous by its absence. Messrs. Richmond and Co., Limited, had a representative show of their stoves on the ground floor of the hall; and so had the Eagle Range and Gas-Stove Company, Limited, both there and in the gallery—the exhibits in the latter place comprising the latest types of "Acme" gas-stoves, carving-tables, hot closets, &c. As usual, Messrs. S. Clark and Co. had a varied and very effective collection of gas heating-stoves, gas and oil bar-stoves, and gas mullers. Gas-engines were shown by Messrs. Crossley Bros., Limited, and by the National Gas-Engine Company, Limited; the former having a 26½-horse, and the latter a 12½-horse power engine at work. The "Stockport" gas-engine may be said to have found a permanent home for the provision of power at the Agricultural Hall. At the stand of Messrs. M'Rae and Co., new types of small gas and oil engines, constructed according to the Gardner patent, were on view. The Matchless Gas Lighting Syndicate and the Incandescent Accessories and Maintenance Syndicate were showing their respective specialities.

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The Penny-in-the-Slot System at Gateshead.—The Newcastle and Gateshead Gas Company have decided to extend the prepayment system into Gateshead. Householders have been informed that three brackets, a pendant, a cooking-stove, and accessories will be fitted up free of cost; and the charge for gas will be 1d. for 29 cubic feet.

Additional Capital for the Maidstone Gas Company.—An extraordinary meeting of the Maidstone Gas Company was recently held to consider the following proposition: "That £15,000 additional consolidated stock of this Company, or such similar amount as may be necessary in the opinion of the Directors, be issued; that the same be sold by public auction; and that the Clerks be instructed to take all necessary steps to carry out this resolution." The Chairman (Mr. G. Marsham) explained that the issue of stock was rendered necessary in consequence of the erection of a new gasholder, the fitting of a fresh boiler, and the laying of mains in various parts of the town to meet increased requirements. The proposal was unanimously agreed to.

The Recent Shipment of American Gas Coal to the Thames.—Writing in reference to the recent consignment of a cargo of American gas coal to the South Metropolitan Gas Company, the European agents for the Perkins Company remind us that this is not the first instance of gas coal from the United States being shipped to England. Some ten years ago, the Company sent a parcel of Youghiogheny gas coal (from Pennsylvania) to the Gaslight and Coke Company, for whom it was tested by Mr. Alfred Kitt, at that time Manager of the Pimlico works. The results of his trial showed a yield of 11,088 cubic feet of 17·66-candle gas from a ton of coal; and in his report he stated that "the coal yielded a very large volume of gas of high illuminating power," and that it was "bright and clean, and gave an excellent coke of high combustible value. The percentage of ash in both coal and coke was exceptionally low; and the proportion of impurities in the coal rendered the gas easy of purification." We are informed that later tests of this coal gave 11,820 cubic feet of 18·19-candle gas per ton.

Conditions of Labour and Rate of Wages for Gas Stokers at West Hartlepool.—The following conditions of labour and rate of wages for gas stokers has been provisionally agreed upon between Mr. T. Bower, representing the Hartlepool Gas and Water Company, and Mr. Lynas, of the Gas Workers' Union, representing the men: (1) That, as soon as convenient, the day's work be altered from twelve to eight hour shifts. (2) That the work of one stoker shall comprise the charging and drawing of two beds of 14 mouthpieces, attending to two fires, wheeling out cinders, and generally doing all that is necessary to work two beds of seven retorts each; Mr. Bower promising to look into the question of cleaning retorts. (3) The quantity of coal to be carbonized in each retort shall be as follows: Minimum, 2¼ cwt.; maximum, 2½ cwt.; mean, 2 cwt. 1 qr. 14 lbs. (4) That the wages be 5s. 6d. per shift, with time and-a-half for Sunday, and double pay for Good Friday and Christmas Day. (5) That, in consideration of the Company granting the foregoing conditions, the workmen are willing to enter into an agreement to serve for a period of two years from the date thereof without re-opening the question of wages or the conditions of labour.

The Proposed Municipal Colliery for Bradford.—In the "Journal" last week, it was mentioned that objection had been raised to the inclusion in the Bill of the Bradford Corporation of the clause to sanction the borrowing of money for purchasing a colliery. As no action could be taken upon the objection without notice, the matter was not proceeded with; but it will be considered at a special meeting to-morrow.

Gas Explosion at the Paris Exhibition.—According to a Reuter telegram, a gas explosion occurred on Monday last week in the section of the Paris Exhibition devoted to gas-engines. The escape was from a pipe conveying gas under the floor of the building; and the planking was blown in all directions. Five persons were struck by fragments; but only one was seriously injured. Prompt medical assistance was rendered.

A Parish Council's Gas Supply Cut Off.—The Parish Council of Amlwch, in Anglesey, have been at loggerheads with the Gas Company, and the dispute has culminated in the latter cutting off the gas supply from the public lamps, and leaving the streets in darkness. The trouble arose out of the rates. The Company had not paid the rates due, and the authorities took legal proceedings. On the other hand, the Council owed a big bill to the Company for lighting the streets; but as this could not be put as a set-off to a claim for rates, the Company retaliated in the way mentioned. Great inconvenience has been caused; and the Local Government Board have been communicated with. The sum due by the Company is about £26; while it is said that the counter-claim amounts to £65.

Additional Storage at the Chesterfield Gas-Works.—Mr. W. A. Ducat, a Local Government Board Inspector, held an inquiry at the Municipal Hall, Chesterfield, last Thursday, into an application by the Chesterfield Gas and Water Board for sanction to borrow £6000 for the erection of a gasholder. Mr. Middleton (Clerk to the Board) explained the circumstances on which the application was based, and said the holder was required to complete the plant. There had been previous applications in respect of purifiers and a new retort-house; but the suggestion to put up a new gasholder of 1½ million cubic feet capacity, at a cost of £20,000, had for the present been abandoned. The Board now proposed to utilize a tank which had collapsed in the time of the old Company. They had a present storage capacity of 200,000 cubic feet; and the daily consumption of gas last winter was 500,000 feet.

Illuminating Gas from Sewage Sludge.—Experiments have recently been made at the sewage-works of the Chorley Corporation, the result of which has been that gas has been manufactured from the sludge. Experiments on a more extensive scale are in progress at the gas-works, under the direction of Mr. J. M'Cubbin, the Engineer and Manager; and it has been demonstrated that 4000 cubic feet of 20-candle gas can be produced from a ton of sludge. So far the experiments have been confined to small quantities of stuff; and it has yet to be determined whether similar results can be produced from the material in bulk, which is now disposed of to farmers at 1s. a ton. In any case, a small plant can be put down for the lighting of the sewage-works and the vicinity. These are the experiments referred to in the letter by Mr. Harman, of Huddersfield, which appears in our "Correspondence" columns.

RICHMOND'S

"TRIUMPH"

Is it a Cooker, or is it a Fire?

Is it new, or is it old?

It is a fire, it'll go on hire,

It is new, so we're told.

RICHMOND'S

Gas-Works Extensions at Ripon.—Gas and electric lighting were in conflict at Ripon last Thursday. The Corporation Gas Committee introduced to the Council a scheme for spending an extra £7000 on the gas-works; and several members strongly opposed the proposal in view of the introduction of the electric light. The Council eventually accepted the Committee's recommendation.

Adoption of Gas Lighting at Baraton (Cheshire).—The township of Barnton, near Northwich, having approved the adoption of the Lighting and Watching Act by a vast majority, the Parish Council on Monday last week decided upon the positions of the lamps and brackets for the public illumination of the district. The work is being executed by the Northwich Gas Company. This improvement will give great satisfaction to a number of persons travelling through the locality to Runcorn, Warrington, and other populous centres.

Gas Poisoning in a Weaving-Shed.—A singular scene was recently witnessed at Holehouse Mill, Blackburn. By some mischance, the gas had been left turned on overnight in the weaving-shed; and before the operatives had been working long they began to feel the effects of the leakage. About a dozen of them had to be carried into the yard, where brandy was administered, and two doctors were summoned to their aid. Three women had to be conveyed home under medical care; but the accident has not been attended by serious results.

Carlisle Gas-Works Extensions.—The Carlisle Gas Committee last Wednesday decided to recommend the Town Council to carry out the scheme prepared by Mr. C. B. Newton, the Corporation Gas Engineer, for the extension of the gas plant on Boustead's Grassing. The scheme recommends that, as a first instalment of a larger scheme, plant for the production of 500,000 cubic feet of coal gas per day be erected at an estimated cost of £33,000. The recommendation, it is stated, will occasion a good deal of discussion in the Council, as there is a strong feeling that the gas-works should be removed outside the town; whereas the Committee contemplate the erection of the new works in a locality which is much populated at present, and bids fair to become more so. It should be mentioned that, when the subject was before the Committee on Wednesday, the proposal to commence the new coal-gas works was only carried by a majority of one—the minority being in favour of putting down a carburetted water-gas plant at the present works as proposed by Mr. Corbet Woodall in his recent report.

More gas storage accommodation is required at Rotherham; and a Sub-Committee of the Gas Committee have been authorized by the Corporation to visit other towns, and inspect various types—columnless and otherwise.

The German Association of Alcohol Manufacturers have offered a prize of 9375 frs. and various others amounting altogether to 5000 frs., for the best incandescent lamps burning alcohol. They must be ready for use after the first lighting, be inexpensive, and the wicks must not be liable to become clogged with resin or char. Particulars may be obtained from the Centrale für Spiritusverwerthung, Berlin, before Dec. 1.

The Keighley Town Council have decided to apply for sanction to the borrowing of £21,279, to cover the capital expenditure incurred and anticipated to June 30, 1902, on account of mains, prepayment meters, gas-stoves, &c.

The Philadelphia Company of Pittsburgh announce that they are laying additional 36, 20, and 16 inch mains from Pittsburgh to connect with their Greene County and West Virginia gasfields; and when they are completed, they will double the carrying capacity from those fields.

Speaking at a meeting held to further his candidature for membership of the Bradford Corporation, Mr. Wesley Knight stated that the Gas Committee had not yet come to an agreement with the Clayton Gas Company. But negotiations were proceeding; and he hoped that a satisfactory settlement would be arrived at before long.

The Gas Engineer of the Buxton Local Board (Mr. H. Barker) has submitted a report on the extensions he suggests should be carried out at the gas-works. He estimates the cost at £26,000, which sum will include £1500 for extensions of mains and a similar amount for prepayment meters. The Council have decided to apply to the Local Government Board for borrowing powers to the extent of the above amount.

The Southport Town Council last Thursday decided to promote a Bill in the ensuing session of Parliament for the purchase, either by agreement or compulsion, of the undertaking of the Southport Water Company, and for the constitution of a Joint Water Board, consisting of representatives of the Corporation, the Birkdale District Council, and the West Lancashire Rural District Council, for the control of the undertaking.

The last meeting of the Manchester City Council for the expiring municipal year will be held to-morrow; and on the *agenda* is Alderman Gibson's notice of motion—"That, in the opinion of this Council, the present system of subsidizing the rates out of the profits of the gas undertaking is wrong in principle, unjust in practice, inimical to the best interests of the ratepayers, and ought to be discontinued." It will be remembered that it was not reached at the last meeting.

Gas managers who may be applied to in respect of private or public intallations of incandescent gas lighting will not have to complain of dearth of material to assist them in selecting suitable appliances for carrying them out. We called attention, in the "JOURNAL" for the 16th inst., to some very artistic fittings which were to be seen at the showrooms of Messrs. Henry Greene and Sons, Limited, in Farringdon Road, of which we had received a catalogue. The firm have since sent us the new illustrated catalogue of lamps referred to in their advertisement in the same issue. It consists of 36 large pages, illustrating the "Beacon," "St. Albans," and other lamps, advertising lanterns, and workshop and window reflecting lights, as well as various accessories of lighting by the incandescent system, such as columns, brackets, enamelled deflectors, anti-vibrators, &c. The illustrations are preceded by some useful remarks on public lighting; and accompanying the catalogue, which is very well printed, is a leaflet describing the method of adapting public lamps for incandescent lighting employed by the firm in connection with the lamps in the South Metropolitan Gas Company's district.

SAWER & PURVES.

(BRANCH OF METERS LIMITED),

Telegraphic Address: "SAWER, MANCHESTER."

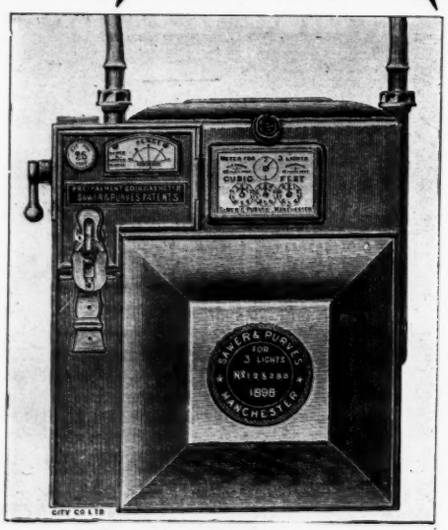
National Telephone: 3289 MANCHESTER.

NELSON METER WORKS, MILES PLATTING,

MANCHESTER.

Makers of Meters fitted with

PATENTED Detachable Prepayment Attachment.



Meter in working position.

Meter with attachment removed without uncoupling.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale than all other Oxides combined. Purity and uniformity of quality guaranteed.

JOHN WM. O'NEILL, Managing Director,
160, 161, & 162, PALMERSTON BUILDINGS,
OLD BROAD STREET,
LONDON, E.C.

ANDREW STEPHENSON, AGENT. All communications *re* Oxide to the Company as above.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for use in GAS-WORKS.

ANDREW STEPHENSON,
182, Palmerston Buildings,
Old Broad Street,
"Volcanism, London." London, E.C.

BROTHERTON & CO.
Offices: Commercial Buildings, LEEDS. Correspondence invited.

ENRICH your Gas with cheap Benzol, Specially prepared, free from sulphur. At to-day's Price of Benzol, ILLUMINATING POWER costs less than ONE-THIRD OF A PENNY PER CANDLE.
Apply to SADLER AND Co., MIDDLESBROUGH.

AMMONIACAL LIQUOR wanted.
BROTHERTON AND Co., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SADLER & CO., Ltd., Middlesbrough, Tar Distillers and Tar Colour Manufacturers. BENZOL specially prepared for Gas Enrichment free from Sulphur. Pure Hydrated OXIDE OF IRON for Purifying Gas either for Sale or Lent on Hire. Always Buyers of GAS TAR and AMMONIACAL LIQUOR.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c., CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special attention to Repairs.
Before placing Orders, please write for Estimate.
Telegraphic Address: "SATURATORS, BOLTON."

GAS TAR wanted.
BROTHERTON AND Co., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

PATENTS FOR INVENTIONS.
Messrs. J. C. CHAPMAN & CO., Chartered Patent Agents, ADVISE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

NEW GAS PLANT CEMENT.
JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
For all Joints in connection with Oil Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

SULPHURIC ACID for Sale.
BROTHERTON AND Co., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

HYDRATED OXIDE OF IRON.
PREPARED from Pure Iron.
Twice as Rich as Bog Ore.
Gives no Back Pressure.
The Cheapest in the Market.
Can be Lent on Hire.
Can be Exchanged for Spent Oxide.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."
[For Illustrated Advertisement, see Oct. 2, p. 864.]

ADVERTISER (Age 32), having a thorough practical knowledge of Gas Making and Distribution, seeks position as WORKING MANAGER for Works making 10 to 15 millions. Well up in Carbonizing, Mains, Services, Meters, &c. Present post, Works Superintendent (making 90 millions). Good References.
Address No. 3586, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM; and 45 & 47, Westminster Bridge Road, LONDON, S.E.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Addresses:
"Braddock, Oldham." "Metrique, London."

SULPHURIC ACID.
JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Waggons or Carboys. Highest references and all particulars supplied on application.

TO GAS AND WATER OFFICIALS.
HIGH-CLASS Cycles at reasonable and low Prices. Guaranteed for Twelve Months. Sent on approval. For Cash or Gradual Payment System. Send for Catalogue, Post Free.
MELROSE CYCLE COMPANY, COVENTRY.

WANTED, a Situation as Manager or WORKS CLERK on a Gas-Works (South of England preferred). Age 30. Good References.
Address Mr. R. Goss, 1, Sunny View, Waterloo Road, Aldershot, HANTS.

RETORT-SETTER requires permanent Situation (at Home or Abroad). Used to Regenerator, Generator, and Direct-Fired Settings. Age 22. Total Abstainer.
Address No. 3589, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GENTLEMAN (age 27), trained as Gas Engineer, at present calling on Gas-Works in the Midlands, will shortly be in a position to REPRESENT good Firm in that or other District. Would not object to go abroad. First-class References.
Address No. 3591, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

DRAUGHTSMAN, competent to take charge, desires Engagement. Thoroughly experienced in Elevating and Conveying Plant for Gas-Works, Regenerative Furnaces, &c. Inclined Retorts a Speciality.
Address No. 3590, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a single Man as Night Man for the Hartley Wintney Gas-Works.
Apply to Mr. KENWARD, Hartley Wintney, Winchfield, HANTS., stating Wages and Reference.

WANTED, immediately, a good, steady Man as STOKER. Constant Employment to a suitable Man. Wages 26s. per week.
Apply to H. WIMHURST, Manager, Gas-Works, SLEAFORD.

METER Repairer wanted. Wages 8½d. per hour; 49½ hours per week. One used to "Penny-in-Slots" preferred.
Apply, by letter, to No. 3587, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FITTERS WANTED.
TWELVE additional Fitters required, used to Compo. and Barrel work. Must be quick and neat. Only good Men need apply.
Give References and Wages required to RICHMOND & Co., LIMITED, DUBLIN.

WANTED, by a large Provincial Gas Company in the South of England, a smart, strong young Man to act as COLLECTOR and INSPECTOR. Commencing Wages, 25s. per week; promotion for a suitable Man.
Apply, by letter, to No. 3588, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO BE LET on Hire—
FACING MACHINE, for facing *in situ* Self-Sealing Retort Mouthpieces any shape or size, ⌀, Oval, or Circular.
PULSOMETER, Size No. 5, with 4-in. suction and 3-in. delivery. Steam-Pipe ¾ in. diameter. Discharge 10,000 Gallons per hour.
Write J. WRIGHT, Bridge House, BLACKFRIARS BRIDGE, E.C.

"CUTLER'S" Condenser, ¾ million day, equal to new; weight 12 tons; accept £100 on rail, Berkshire, if sold promptly.
J. F. BLAKELEY, Thornhill, DEWSBURY.

HIGH-PRICED COAL.
SMALL Gas-Works Authorities should immediately adopt an EXHAUSTER, and thus make probably at least 750 cubic feet of gas more from each ton of Coal carbonized. Several small sets *in stock*, both New and Second-hand.
Address J. FIRTH BLAKELEY AND Co., Thornhill, DEWSBURY.

GAS PURIFICATION.
OXIDE OF IRON BOG ORE.
BALE & CO.'S Oxide of uniform quality. SPECIAL FIRE CEMENT, OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

CANNEL, COAL, ETC.
JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application.
No. 30, ST. ANDREW SQUARE, EDINBURGH, } SCOTLAND.
NEWTON GRANGE, NEWBATTLE, DALKEITH, }

FOR SALE—260 22 in. by 15 in. and 135 20 in. by 14 in. second-hand ⌂-shaped Retort Mouthpieces, fitted complete with Tangyes Patent Lids, 18 inches diameter.
Can be inspected on application to Mr. T. Hardie, Manager, Gas-Works, Redheugh, Gateshead-on-Tyne.
Offers to be addressed to the SECRETARY, 35, Grainger Street West, NEWCASTLE-ON-TYNE.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

FOR SALE—
Four HYDRAULIC PRESSES, 14 inches diameter Rams.
Six HYDRAULIC PRESSES, 12 inches diameter Rams.
Two HYDRAULIC PUMPS.
Ten Gun-Metal STOP-VALVES.
Two 12-inch HYDRAULIC PRESSURE-GAUGES.
One 14-inch HYDRAULIC PRESSURE-GAUGE.
Also Three COPPER CYLINDRICAL EGG-ENDED TANKS.
All in good condition, and ready for work.
Can be seen by appointment at the Gaslight and Coke Company's Tar and Ammonia Products Works, Beckton, near North Woolwich.
For further Particulars, apply to Mr. T. WILTON, Manager.

J. FIRTH BLAKELEY & CO., Thornhill, Dewsbury, have FOR SALE:—
One Set of Three 6-ft. PURIFIERS.
One ,, Two 8-ft. ,,
One ,, Four 8-ft. ,,
One ,, Four 16-ft. by 12-ft. PURIFIERS.
Four 10-inch ,, ,,
Six 16-inch ,, ,,
"Cutler" ¾ million WATER" CONDENSER.
Wrought-Iron TOWER SCRUBBERS, 3 ft. by 14 ft., 3 ft. 6 in. by 27 ft., and 7 ft. by 32 ft.
Cast-Iron TOWER SCRUBBERS, 3 ft. 6 in., 5 ft., and 6 ft. diameter.
EXHAUSTERS, 2000 to 60,000 Cubic Feet per hour.
"Holmes" & "Clapham" WASHER-SCRUBBERS.
"Livesey" & "Cripps" WASHERS.
4-in., 6-in., 8-in., and 10-in. STATION METERS.
Splendid GASHOLDER, 50 ft. by 20 ft.
RETORT IRONWORK, MODERN HYDRAULICS.
Telegrams: "BLAKELEY, THORNHILL LEES."

FIRE-CLAY GOODS.
THE Directors of the Sheffield United Gaslight Company invite TENDERS for the supply of SILICA and FIRE-CLAY GOODS, required at their Neepsend, Effingham Street, and Grimesthorpe Stations during the next Twelve Months.
Specifications and Forms of Tender may be obtained on application to the Company's Engineer, Mr. J. W. Morrison.
The Directors do not bind themselves to accept the lowest or any Tender.
Sealed Tenders, marked "Tender for Fire-Clay Goods," must be delivered by post to the undersigned not later than the first post on Saturday, Nov. 3.
HANBURY THOMAS,
General Manager and Secretary.
Commercial Street, Sheffield,
Oct. 15, 1900.

BOROUGH OF BURTON-UPON-TRENT.
FIRE-CLAY GOODS.
THE Gas and Electric Light Committee invite TENDERS for the supply of the FIRE-CLAY RETORTS, BRICKS, and CLAY required at the Gas-Works during the Year 1901.
Full Particulars of the Specification and Conditions, with Form of Tender, may be obtained on application to the undersigned, to whom sealed Tenders, endorsed "Fire-Clay Goods," must be delivered on or before Thursday, the 22nd day of November inst.
The lowest or any Tender will not necessarily be accepted.
F. L. RAMSDEN,
Manager and Engineer.
Gas and Electric Light Works,
Burton-upon-Trent, Nov. 1, 1900.

MANCHESTER CORPORATION.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply and delivery of the FIRE-CLAY GOODS required, during next Season, at their several Gas-Works.

Full Particulars and Forms of Tender may be obtained from Mr. C. Nickson, Superintendent, at the Gas Offices, Town Hall, Manchester, on payment of a deposit of Two Guineas, which will be returned on receipt of a *bonâ-fide* Tender.

Sealed Tenders, endorsed "Tender for Fire-Clay Goods," addressed to the Chairman of the Gas Committee, Town Hall, Manchester, are to be delivered at the Gas Offices, Town Hall, not later than Tuesday, the 20th day of November, 1900.

By order,
WM. HENRY TALBOT,
Town Clerk.

Town Hall, Manchester,
Oct. 26, 1900.

SCARBOROUGH GAS COMPANY.

SALE BY TENDER OF NEW ORDINARY STOCK.
IN PURSUANCE OF THE SCARBOROUGH GAS ACT, 1895.

NOTICE is Hereby Given, that it is the intention of the Directors of this Company to SELL BY TENDER NEW ORDINARY STOCK of the Company, to the amount of £8000, or such greater or less amount as shall, with premiums, realize the sum of £9757 10s. 3d., such Stock to bear a maximum Dividend of £5 per cent. per annum, and to be paid up in full on or before the 1st day of January, 1901; being the balance of the Additional Capital authorized to be raised under the powers of the above-named Act, by a Resolution passed at a Meeting of the Proprietors of the Company, specially convened for the purpose, and held on the 26th day of June, 1895.

Particulars and Condition of Tender may be obtained on application at this Office; and sealed Tenders must be sent in not later than Twelve o'clock at noon on the 1st day of December, 1900.

By order,
J. HOLLIDAY,
Secretary.

Scarborough Gas Company's Offices,
32, Westborough, Scarborough, Oct. 22, 1900.

NEWCASTLE-UPON-TYNE AND GATESHEAD GAS COMPANY.

SALE OF ORDINARY STOCK.

THE Directors have instructed Mr. ROBERT MACK to SELL BY AUCTION, at the Offices of the Company, Newcastle-upon-Tyne, on Wednesday, the 7th day of November, 1900, at Twelve o'clock at noon,

TWENTY-FIVE THOUSAND POUNDS
ORDINARY STOCK

of the Company, to be issued under the Powers of the Company's Act of 1896.

For Conditions of Sale and further Particulars, apply to the undersigned.

THOMAS WADDOM,
Secretary.

Offices: 35, Grainger Street West,
Newcastle-upon-Tyne.

RUGBY.
RE PETER SIMPSON (DECEASED).

GAS AND WATER SHARES, &c.

MR. J. R. TAIT has been instructed by the Executors of the late Peter Simpson, to SELL BY AUCTION, at the Royal George Hotel, on Wednesday, the 7th day of November, 1900, at Two for Three o'clock, subject to Conditions of Sale to be then produced, the following Gas and Water Shares—viz.,

LOT 2.
16 SHARES of £10, fully-paid, in the ALLIANCE and DUBLIN CONSUMERS' GAS COMPANY. The last Dividend was 10½ per cent.

LOT 3.
£285 ORIGINAL STOCK in the GREAT WIGSTON GAS COMPANY. Last Dividend, 7½ per cent.

LOT 4.
£350 NEW ORDINARY STOCK in the GREAT WIGSTON GAS COMPANY. Last Dividend, 5¼ per cent.

LOT 5.
Five SHARES of £5 each, £3 10s. paid, in the DUNCHURCH GAS COMPANY. Last Dividend in 1893, 3 per cent.

LOT 6.
30 £10 6 per cent. "C" PREFERENCE SHARES in the ALDERSHOT GAS AND WATER COMPANY.

LOT 7.
30 SHARES of £10 each, fully-paid, in the NEWENT GAS COMPANY. Last Dividend, 3½ per cent.

LOT 8.
Eight 4 per cent. MORTGAGED DEBENTURES of £50 each in the NEWENT GAS COMPANY.

LOT 9.
Six SHARES of £20 each, fully-paid, in the MONTE VIDEO GAS COMPANY. Last Half-Year's Dividend at 2 per cent.

LOT 10.
13 £20 5 per cent. DEBENTURE BONDS in the MONTE VIDEO GAS COMPANY.

LOT 11.
25 SHARES of £1, fully-paid, in the RUGBY COFFEE TAVERN COMPANY, LIMITED. Last Dividend, 7½ per cent.

LOT 12.
38 SHARES of £10 each, fully-paid, in the RUGBY GAS COMPANY. Last Dividend, 13 per cent.

LOT 13.
49 SHARES of £10 each, £8 10s. paid, in the RUGBY GAS COMPANY. Last Dividend, 13 per cent.

LOT 14.
13 SHARES of £10 each, £8 10s. paid, in the RUGBY GAS COMPANY. Last Dividend, 13 per cent.

Further Particulars may be had on application to the AUCTIONEER, 2, Albert Street, RUGBY; or to Messrs. FREDERICK FULLER AND SON, Solicitors, Albert Street, RUGBY.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
ILFORD GAS COMPANY.

£5000 ORDINARY STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Nov. 6, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
EPSOM AND EWELL GAS COMPANY.

NEW ISSUE OF £3000 FOUR PER CENT.
PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Nov. 6, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Executors of H. W. Ulph, Esq., deceased, and other Owners.

GAS AND WATER STOCKS AND SHARES

In the British Gaslight Company, Brentford Gas Company, Barnet District Gas and Water Company, East Cowes Gas Company, and the Goring and Streatley Gas and Water Company.

MR. ALFRED RICHARDS will Sell the ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Nov. 6, at Two o'clock, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
WANDSWORTH AND PUTNEY GASLIGHT AND COKE COMPANY.

NEW ISSUE OF £30,000 NEW ORDINARY STOCK.

MR. ALFRED RICHARDS will Sell by AUCTION at the Mart, E.C., on Tuesday, Nov. 13, at Two o'clock, in Lots.

£30,000 of NEW ORDINARY STOCK

in the above Undertaking, ranking for a Standard Dividend of 3½ per cent., subject to the Sliding-Scale, and entitled under the present price charged for Gas to a Dividend of £5 1s. 6d. per cent.

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BRISTOL WATER-WORKS COMPANY.

SALE OF ORDINARY STOCK.

MESSRS. ALEXANDER, DANIEL, & CO., will SELL BY AUCTION, at the Bank Auction Mart, Corn Street, Bristol, on Thursday, the 8th of November, 1900, at Two o'clock in the Afternoon,

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BRISTOL WATER-WORKS 7 PER CENT. MAXIMUM CONSOLIDATED ORDINARY STOCK, in Lots of £100,

at the Reserved Price of £160 for every £100 Stock.

The above £15,000 Stock is part of the 7 per cent. Maximum Consolidated Ordinary Stock, amounting to £690,000, created under the powers of the Bristol Water-Works Acts, 1888, 1889, and 1895.

The Dividend is subject to proportionate diminution whenever the Maximum Dividend to which each class of Ordinary Shares or Ordinary Stock of the Company is entitled shall not be paid in full; but such diminution may be made up in subsequent Years.

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AND OF THE

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OF

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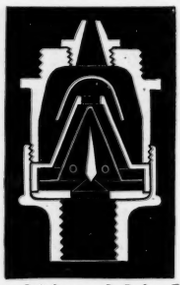

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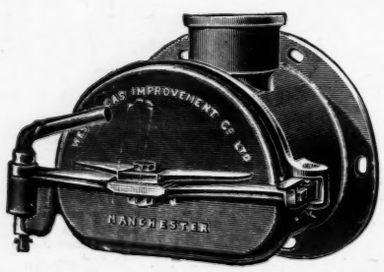

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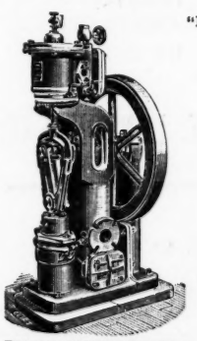

Fig. 705. "SINGLE RAM" STEAM-PUMP.

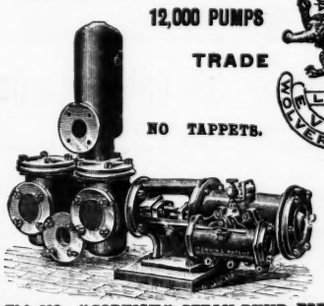

Fig. 593. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

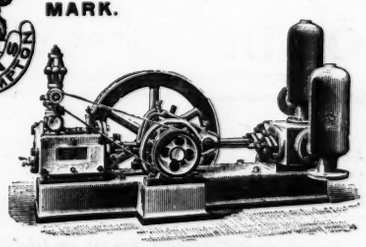

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

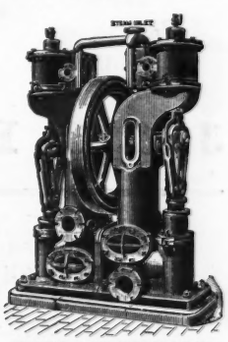

Fig. 713. "DOUBLE-RAM" STEAM-PUMP.

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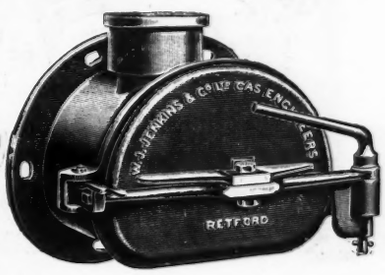

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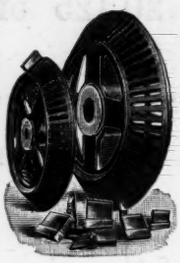

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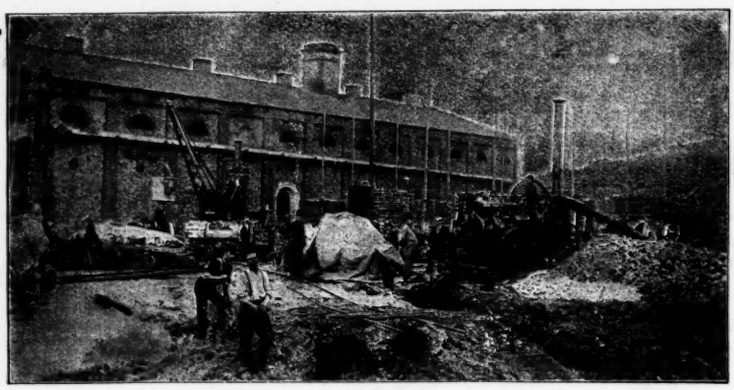

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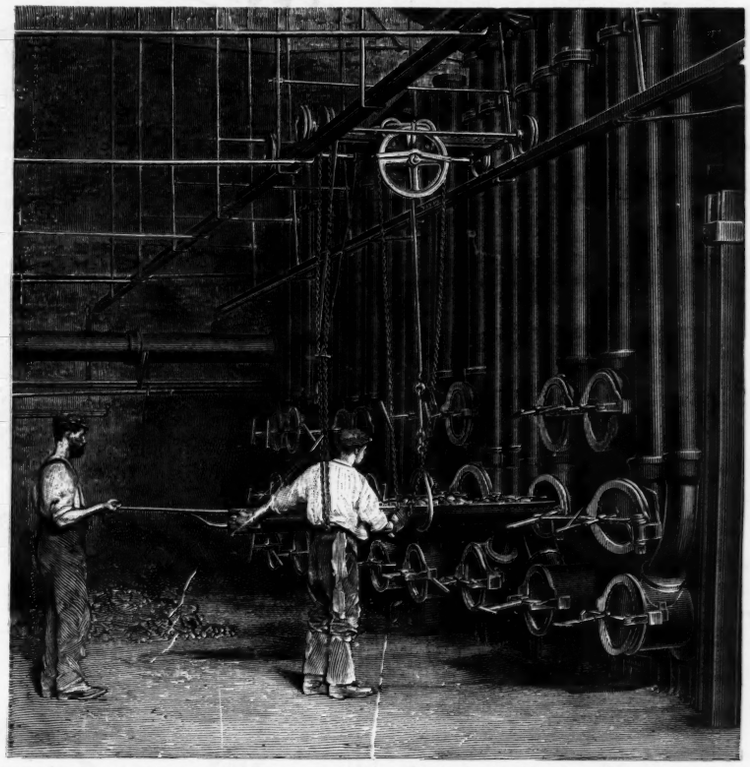

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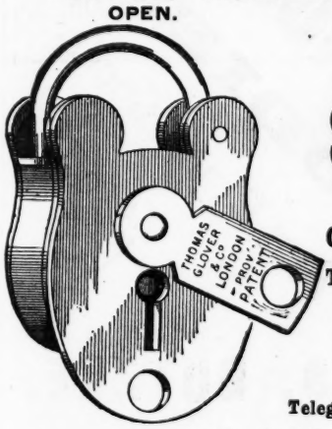

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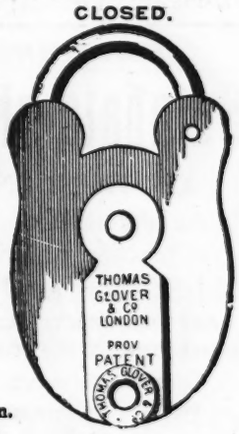

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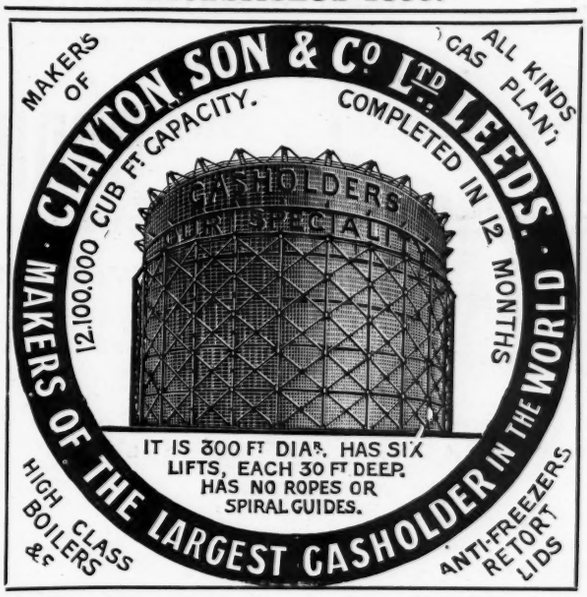
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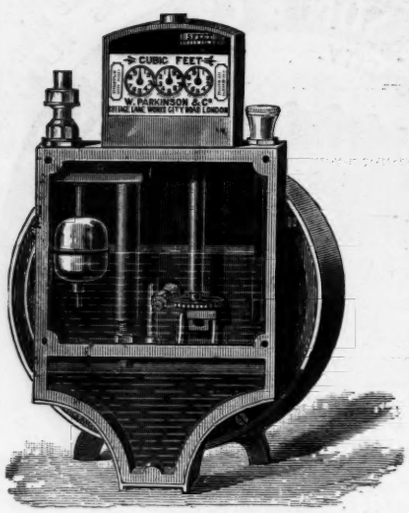

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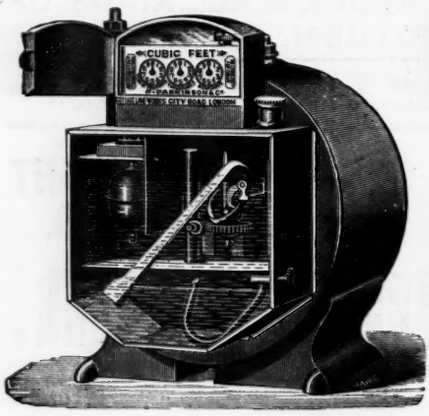

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[See also Advt. on p. 1070.

LONDON: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London,—Tuesday, Oct. 30 1900.